NWASNEWS

Volume22, Issue 8

April 2017

Newsletter for the Wiltshire, Swindon, Beckington Astronomical Societies and Salisbury Plain Observing Group

Space and Astronomy

It is very easy to forget our hobby covers so many aspects of sciences and engineering and it can become a rewarding introduction to many school subjects from a practical use of learning for many (I carefully do not just say children, I feel I am learning something all the time).

Looking through the news pages even in this precise type newsletter reveals the implementation of mathematics, engineering (reuse of Falcon X could be a big boost for space exploration, and they are going to try to strap to reused booster on a larger rocket for the heavy launcher later this year—and attempt recovery (with numerous caveats).

Biology and Earth Sciences fall into the Earth study satellite cut back, but also the Mars orbiter findings still going on after 55,000 orbits.

Imagine the communications sciences in use to still talk and receive data from the Rosetta mission, now reporting changes on the surface from the comet CG pass closer to the Sun.

Planetary, X Ray , and Telescope building also appear, and the community science project launched in StarGazing live last work to help look for Planet 9 (or 114 depending on definition changes).

3 comets are visible through binoculars at the moment. So many areas for even the amateur to get involved.

I know our speaker this evening, Dr Chris North, will be very interested in this outreach for astronomy, and I still believe this is a very important job for local societies to reach and support schools and the public.

Pete Glastonbury has shown how a little personal dedication can make a big difference, and his work with an autistic boy in Devizes has paid off for young Alex with giant strides in his other school work.

I still get a lot of questions from the public as half information is fed to them from the vastly expanded media that the internet age has allowed. What is a snow moon? How do I see the Pink Moon? What is a supermoon?

Can we see the planets around stars with our binoculars and telescopes?

So many questions, and in the age of Fake News we must be on our toes to keep up with what is being discovered.

Our speakers that Peter Chappell arrange cover a huge range of topics so at least you can be informed about what we know, and what we don't know from the best authorities there are.

Clear Skies

Andy

The Sun after a very quiet March for visible sunspots, but here on April 2nd three active solar regions can be seen running close to the Sol equator (inclined in this picture bottom left to top right. The Sunspots are tiny., as can be expected at the end of the current solar cycle.
Andy Burns 70mm Halpha filter on Televue 127, imaged using DMK52au video camera.

Wiltshire Society Page

Wiltshire Astronomical Society
Web site: www.wasnet.org.uk
Meetings 2015/2016Season.
NEW VENUE the Pavilion, Rusty Lane, Seend
Meet 7.30 for 8.00pm start
2017

4 Apr	Dr Chris North, Telescopes through the Ages
2 May	Martin Griffiths, Planetary Nebulae Marathon
6 Jun	Mark Radice, Observing from the Caribbean + AGM

Membership Meeting nights £1.00 for members £3 for visitors

Wiltshire AS Contacts

Andy Burns (Chairman, and Editor) Tel: 01249 654541, email: anglesburns@hotmail.com

Vice chair: Keith Bruton

Bob Johnston (Treasurer)

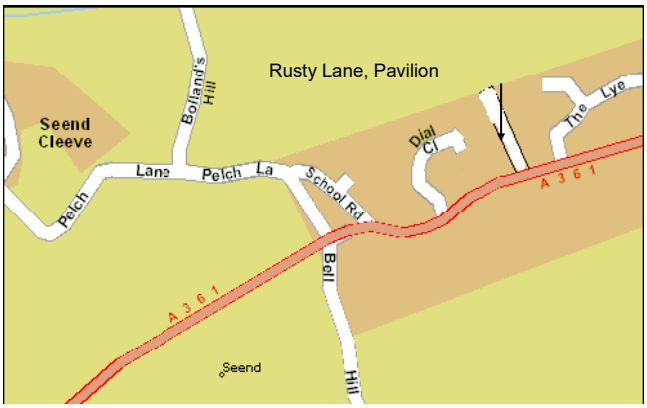
Philip Proven (Hall coordinator)

Peter Chappell (Speaker secretary)

Nick Howes (Technical Guru)

Observing Sessions coordinators: Jon Gale, Tony Vale

Contact via the web site details. This is to protect individuals from unsolicited mailings.

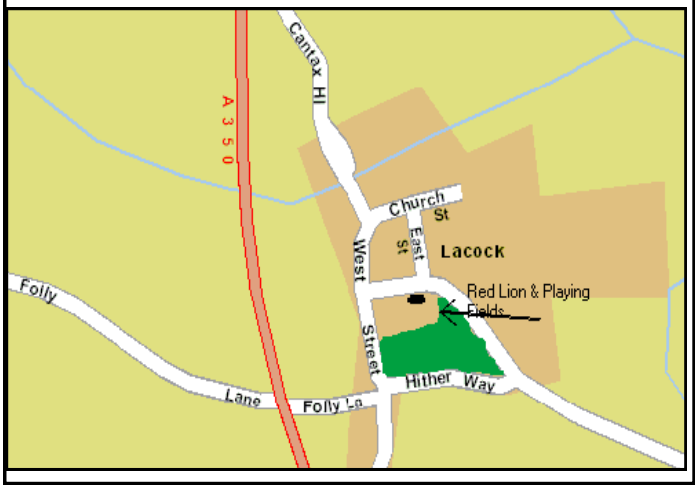


Observing Sessions

The Wiltshire Astronomical Society's observing sessions are open, and we welcome visitors from other societies as well as members of the public to join us.
We will help you set up equipment (as often as you need this help), and let you test anything we have to help you in your choice of future astronomy purchases.

Please treat the lights and return to full working order before leaving. With enough care shown we may get the National Trust to do something with them!

PLEASE see our proposed changes to the observing sessions, contacting and other details. Back Page



Dr Chris North is the Ogden Science Lecturer for Cardiff University, working with the Ogden Trust to encourage take-up of physics at school and University. I also hold an STFC Public Engagement Fellowship, focussing on Gravitational Wave research.

My astronomy research focuses on the SPIRE instrument onboard the Herschel Space Observatory, which observes far-infrared and submillimetre light from gas and dust in our galaxy and beyond. My specific work is relating to the calibration of the instrument, ensuring that the data produced is as accurate as possible.

As well as scientific research, I am involved with outreach relating to the Herschel Space Observatory and the Planck Satellite.

I am a member of the team behind popular online astronomy websites such as Chromoscope, Design a Space Telescope, Multiwavelength Universe and the CMB Simulator.

Swindon Stargazers

Swindon's own astronomy group

The club meets once a month at Liddington Hall, Church Road, Liddington, Swindon, SN4 0HB at 7.30pm. See programme below.

The Ancient Egyptians and their Astronomy

This month we welcome Dr Pauline Norris to our club meeting.
Pauline obtained a Master of Philosophy degree in Agricultural Science at the University of Aberystwyth in Wales. She then changed to Egyptology and passed her MA at the University of Birmingham, focusing on the horse and chariot in the Eighteenth and Nineteenth Dynasties. After this, she graduated with a Doctorate in Egyptology from the University of Manchester, researching the association of the god Min with the lettuce plant and is continuing this research whilst currently writing a book about the god.

She is a member of the Newtown Astronomy Society in Powys, Wales and has given talks throughout England, Wales and in Egypt on a variety of topics connected with the ancient Egyptians.

All welcome!

Ad-hoc viewing sessions

Regular stargazing evenings are being organised near Swindon. To join these events please visit our website for further information.

Lately we have been stargazing at Blakehill Farm Nature Reserve near Cricklade, a very good spot with no distractions from car headlights.

We often meet regularly at a lay-by just outside the village of Uffcott, near Wroughton. Directions are also shown on the website link below.

When we use East Kennett, we meet at the public car park just below The Red Lion pub at Avebury; we usually hang on for 10 minutes and then move on to our viewing spot at East Kennett. Information about our evenings and viewing spots can be found here:

http://www.swindonstargazers.com/noticeboard/noticeboard06.htm

If you think you might be interested email the organiser Robin Wilkey (see website). With this you will then be emailed regarding the event, whether it is going ahead or whether it will be cancelled because of cloud etc.
We are a small keen group and I would ask you to note that you DO NOT have to own a telescope to take part, just turn up and have a great evening looking through other people's scopes. We are out there to share an interest and the hobby. There's nothing better than practical astronomy in the great cold British winter! And hot drinks are often available, you can also bring your own.

Enjoy astronomy at it's best!

Members of the Wiltshire Astronomical Society always welcome!

At Liddington Village Hall, Church Road, Liddington, SN4 0HB – 7.30pm onwards

The hall has easy access from Junction 15 of the M4, a map and directions can be found on our website at:

http://www.swindonstargazers.com/clubdiary/directions01.htm

Meeting Dates for 2017:
Friday 24 April 2017

Programme: Dr Pauline Norris - The Ancient Egyptians and their Astronomy

Friday 19 May 2017

Programme: Martin Griffiths - Contact with extraterrestrials, how will it affect us

Friday 16 June 2017

Programme: Paul Roche - Robotic Astronomy

---------SUMMER BREAK--------

Friday 15 September 2017

Programme: Prof. Richard Harrison MBE BSc Phs FRAS FinstP - Space Weather

Friday 20 October 2017

Programme: Steve Tonkin - Binocular Astronomy

Friday 17 November 2017

Programme: Mike Leggett: Exploration of Mars

Friday 15 December 2017

Programme: Christmas Social

Website:
http://www.swindonstargazers.com
Chairman: Peter Struve

Tel No: 01793 481547
Email: peter.struve@sky.com
Address: 3 Monkton Close, Park South, Swindon, SN3 2EU

Secretary: Dr Bob Gatten (PhD)
Tel Number: 07913 335475

Email: bob.gatten@ntlworld.com
Address: 17, Euclid Street,

Swindon, SN1 2JW

What It's Like on a TRAPPIST-1 Planet

By Marcus Woo

With seven Earth-sized planets that could harbor liquid water on their rocky, solid surfaces, the TRAPPIST-1 planetary system might feel familiar. Yet the system, recently studied by NASA's Spitzer Space Telescope, is unmistakably alien: compact enough to fit inside Mercury's orbit, and surrounds an ultra-cool dwarf star—not much bigger than Jupiter and much cooler than the sun.

If you stood on one of these worlds, the sky overhead would look quite different from our own. Depending on which planet you're on, the star would appear several times bigger than the sun. You would feel its warmth, but because it shines stronger in the infrared, it would appear disproportionately dim.

"It would be a sort of an orangish-salmon color—basically close to the color of a low-wattage light bulb," says Robert Hurt, a visualization scientist for Caltech/IPAC, a NASA partner. Due to the lack of blue light from the star, the sky would be bathed in a pastel, orange hue.

But that's only if you're on the light side of the planet. Because the worlds are so close to their star, they're tidally locked so that the same side faces the star at all times, like how the Man on the Moon always watches Earth. If you're on the planet's dark side, you'd be enveloped in perpetual darkness—maybe a good thing if you're an avid stargazer.

If you're on some of the farther planets, though, the dark side might be too cold to survive. But on some of the inner planets, the dark side may be the only comfortable place, as the light side might be inhospitably hot.

On any of the middle planets, the light side would offer a dramatic view of the inner planets as crescents, appearing even bigger than the moon on closest approach. The planets only take a few days to orbit TRAPPIST-1, so from most planets, you can enjoy eclipses multiple times a week (they'd be more like transits, though, since they wouldn't cover the whole star).

Looking away from the star on the dark side, you would see the outer-most planets in their full illuminated glory. They would be so close—only a few times the Earth-moon distance—that you could see continents, clouds, and other surface features.

The constellations in the background would appear as if someone had bumped into them, jostling the stars—a perspective skewed by the 40-light-years between TRAPPIST-1 and Earth. Orion's belt is no longer aligned. One of his shoulders is lowered.

And, with the help of binoculars, you might even spot the sun as an inconspicuous yellow star: far, faint, but familiar.

Want to teach kids about exoplanets? Go to the NASA Space Place and see our video called, "Searching for other planets like ours": https://spaceplace.nasa.gov/exoplanet-snap/

This artist's concept allows us to imagine what it would be like to stand on the surface of the exoplanet TRAPPIST-1f, located in the TRAPPIST-1 system in the constellation Aquarius. Credit: NASA/JPL-Caltech/T. Pyle (IPAC)

BECKINGTON ASTRONOMICAL SOCIETY

Society Details & Speakers programme can be found on our Website www.beckingtonas.org

General enquiries about the Society can be emailed to chairman@beckingtonas.org.

Our Committee for 2016/2017 is

Steve Hill----------Chairman- 01761 435663

John Ball----------Vice Chairman- 01373 830419

…….john@abbeylands1.freeserve.co.uk

Sandy Whitton---- Secretary-07974-841239

……..sandy.whitton@blueyonder.co.uk

Jacky Collenette---Treasurer…
collenettejacqueline@yahoo.co.uk

Mike Witt---------- Membership-……
mjwitt@blueyonder.co.uk.

John Dolton------
Committee…. member@jdolton.freeserve.co.uk

Meetings take place in Beckington Baptist Church Hall in Beckington Village near Frome.

See the location page for details of how to find us on our website……

Post Code for Sat Nav is BA11 6TB.

Our start time is 7.30pm.

Programme details for 2016/2017

2016

Apr 21st: Observing the Solar System……. Mark Radice

May 19th: Imaging Colloquium `Open discussion bring your kit along`…… Steve Hill.

All are welcome to come along for a chat from beginners to experts.

Dear Herschellians,

For our April lecture we are combining with the BRLSI History & Culture Group and Science Group, since the subject crosses many boundaries! The usual poster is attached, please see it for more information.

Venue: 7.30pm Monday 10th April 2017 at the BRLSI

Title: The Life & Times of Mary Somerville

Speaker: Dr Claire Brock of the University of Leicester

Description:
Mary Fairfax Somerville (26 December 1780 – 29 November 1872) was a Scottish science writer and polymath. She studied mathematics and astronomy, and was nominated to be jointly the first female member of the Royal Astronomical Society at the same time as **Caroline Herschel**.
In 1816 the Mary Somerville and her family moved to London, where they became friends with such eminent scientists as astronomers **Sir William Herschel** and **Caroline Herschel**, metallurgist William Hyde Wollaston, physicist Thomas Young, and mathematician Charles Babbage. On a trip to Europe in 1817, Somerville met French mathematician Pierre-Simon Laplace.
In 1827 Somerville was asked by the lawyer Henry Brougham to prepare for the Society for the Diffusion of Useful Knowledge—which intended to make good books available at low prices to the working class—a condensed version of Laplace's five-volume work Traité de mécanique céleste (Celestial Mechanics, 1798–1827), which offered a complete mechanical interpretation of the solar system. After four years Somerville finished, but Brougham deemed the work too long. However, astronomer **Sir John Herschel** considered the book excellent and recommended Mechanism of the Heavens (1831) to another publisher. Mechanism of the Heavens's introduction, in which Somerville summarized the current state of astronomical knowledge for the general reader, was published separately in 1832 as Preliminary Dissertation to the Mechanism of the Heavens. Mechanism of the Heavens was acclaimed by British mathematicians and astronomers.
Dr Claire Brock is the author of *The Comet Sweeper: Caroline Herschel's Astronomical Ambition.* *The Comet Sweeper: Link to Amazon*
Hope to see you there!

Tony Symes

NAMING THE FULL MOONS

The April full moon will rise this month on on Tuesday (April 11), reaching its fullest phase late at night, just after the bars close in most cities on the U.S. East Coast.

Date	Name	U.S. East	UTC
Jan. 12	Wolf Moon	6:34 a.m.	11:34
Feb. 10	Snow Moon	7:33 p.m.	00:33 (2/11)
Mar. 12	Worm Moon	10:54 a.m.	15:54
Apr. 11	Pink Moon	2:08 a.m.	07:08
May 10	Flower Moon	5:43 p.m.	22:43
June 9	Strawberry Moon	9:10 a.m.	14:10
July 9	Buck Moon	12:07 a.m.	05:07
Aug. 7	Sturgeon Moon	2:11 p.m.	19:11
Sept. 6	Harvest Moon	3:03 a.m.	08:03
Oct. 5	Hunter's Moon	2:40 p.m.	19:40
Nov. 4	Beaver Moon	12:23 a.m.	05:23
Dec. 3	Cold Moon	10:47 a.m.	15:47

April's full moon is known as the Pink Moon, but don't expect it to look particularly pink. It is named after pink flowers called wild ground phlox, which bloom in early spring and become widespread throughout the U.S. and Canada this time of year.

Technically, the full phase — when the moon is on the exact opposite side of the Earth as the sun — happens at **2:08 a.m. EDT (0608 GMT)**. For skywatchers on the West Coast, the moon will reach peak fullness at **11:08 p.m. PDT on Monday (April 10)**. That said, the moon will appear full to casual observers everywhere from April 10 to April 12.

For Northern Hemisphere observers along the East Coast, the sun and moon will rise and set nearly simultaneously. On April 10, the sun will rise over New York City at 6:25 a.m. local time, just 3 minutes after the moon dips below the horizon. That evening, the moon will rise at 7:03 p.m., nearly half an hour before sunset. On Tuesday (April 11), the moon will set at 6:22 a.m., preceding the sunrise by only 1 minute. Thirty minutes after sunset, the moon will reappear at 8:02 p.m. — about 3 hours before its fullest phase. On Wednesday (April 12), the moon will be just past full and won't rise until 8:59 p.m. EDT.

Observers in Los Angeles will see the fullest lunar phase on Monday night, and as the city is farther south than New York, the moon will be somewhat higher in the sky over the course of the evening. That means the differences between moonset and sunrise are a bit different than New York, with moonrise at 7:04 p.m. and sunset at 7:21 p.m. – the amount of time the moon and sun share the sky is cut nearly in half. To find out when the moon will be out at your location, check out this moonrise and moonset calculator.

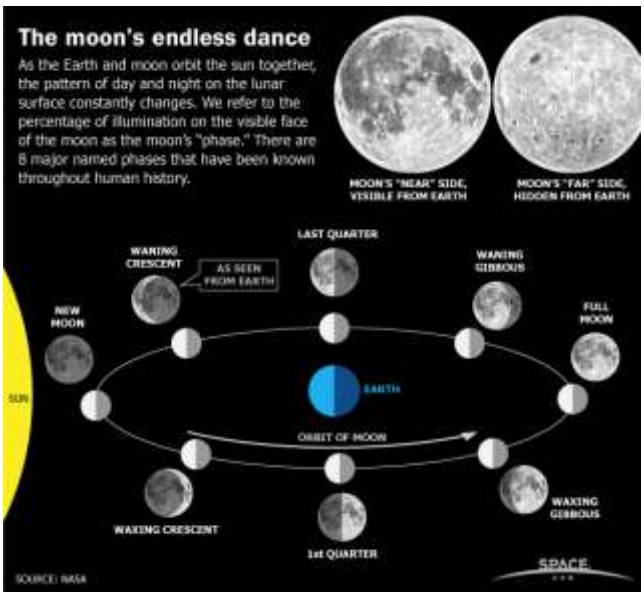
Moon phases explained

A full moon occurs every 29.5 days, when the side of the moon that faces the Earth is fully illuminated. The exact timing depends on where the moon is in its orbit around the Earth, which is why it doesn't always occur at night for viewers in different locations.

The phases of the moon occur because we see it from different perspectives as it revolves around the Earth. When the moon is 90 degrees to the left or right of the line connecting the Earth and sun, it's half-illuminated. Confusingly, this is called a quarter moon, but that's because it's a quarter of the way around its orbit.

The moon moves relatively quickly against the background stars; a careful observer might see it move east about a half a degree, or one moon diameter, per hour. Over the course of a 12-hour night, that's 6 degrees, which can take it right out of one constellation and into another.

On the evening of Sunday (April 9), the moon will rise in the Virgo constellation, about 12 degrees east of Jupiter. By the time it sets Monday morning, Jupiter and the moon will be only 7 degrees apart. On Monday night, when the moon still looks full and rises, it will be within 2 degrees of Jupiter. The closest approach won't be visible to people in the U.S., but those in Europe and points east should be able to see it. U.S.-based skywatchers will have to be satisfied with seeing Jupiter rise just a few minutes before the center of the moon gets above the horizon, though over the course of the night the moon will pass near Spica and form a small, bright triangle with Jupiter.



When the moon is full it's easy to see some details – the lunar maria, for example. Those large, dark areas are lava plains, created by huge impacts that penetrated the crust. With a small telescope or binoculars one can see more details, but the full moon is so bright that a filter is needed to help bring them out. In fact, if looking with a larger telescope, it's sometimes harder to see details of the terrain because there are few shadows during the full moon

What's a Pink Moon?

In many cultures, people named the full moons as they happened throughout the year; it was a way to keep time. Now we sometimes use nicknames derived from Native American myth or old European folk tales. According to the Old Farmer's Almanac, the April full moon is known as the Pink Moon because it marked the appearance of a flower called the moss pink, or phlox. That's likely a Native American tradition because phlox is common in North America and Siberia, as opposed to Europe. It is also called the Sprouting Grass Moon, the Egg Moon and the Fish Moon.

April full moons mark festivals and holidays in other parts of the world: in India, Hindus celebrate the birth of Hanuman in a festival called Hanuman Jayanti. The April full moon will also mark the beginning of Passover for the Jewish people. In Arabic-speaking Islamic traditions, the night of the full moon is called *badr*, for full, but the root of the word also has connotations of health and beauty, says Fadwa El Guindi in "By Noon Prayer: The Rhythm of Islam."

For Christians in England, April was known by the Old English name *ēastre-monaþ*, or "Easter month." The date of Easter is the first Sunday following the full moon that itself follows the vernal equinox, on March 21. This year Easter falls on April 16, a week after the full moon.

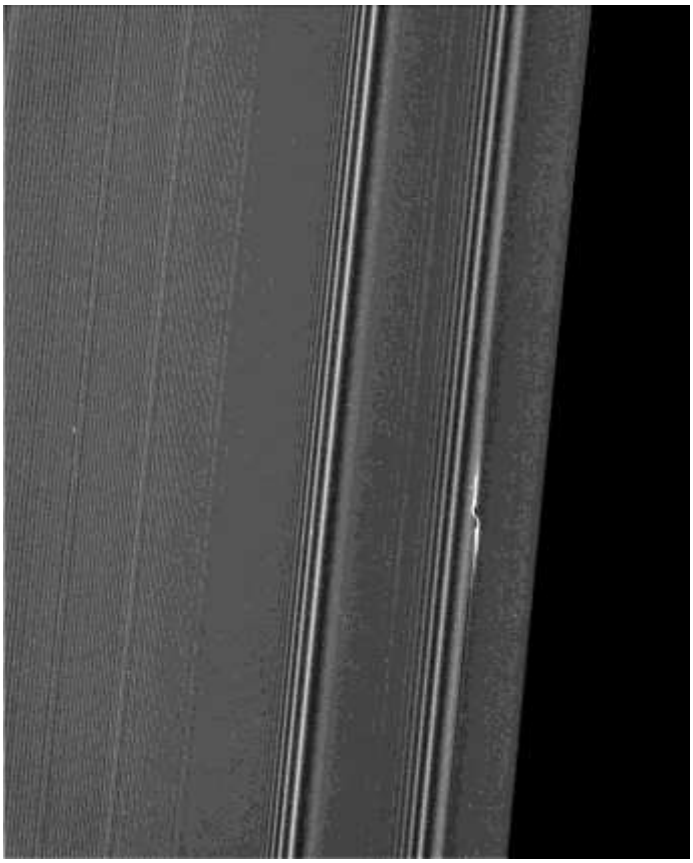
From Space.com

SPACE NEWS

Saturn's 'Earhart' Propeller

Credit: NASA/JPL-Caltech/Space Science Institute

Monday, April 3, 2017: Embedded within Saturn's rings are



several mini-moons, or moonlets, that create propeller-shaped gaps in the ring material. NASA's Cassini spacecraft captured this close-up view of one of these propellers, informally named Earhart, in Saturn's A ring on March 22. To the right of the propeller is the 200-mile-wide (320-kilometer-wide) Encke Gap, a space in Saturn's rings caused by the orbit of a moon called Pan, which is about 1,000 times more massive than Earhart. If Earhart were as big as Pan, it might have enough gravity to clear a similar gap. But the moonlet is only massive enough to create this small, propeller-shaped opening. — Hanneke Weitering

News From Micheal Alexanderm

Press Release

TMT International Observatory and Instituto de Astrofisica de Canarias (IAC) Sign Agreement on Hosting the Thirty Meter Telescope in La Palma, Spain

29/3/2017

PASADENA, CALIFORNIA – Clearing a major milestone to construct and operate the Thirty Meter Telescope (TMT) in La Palma, Canary Islands, the TMT International Observatory (TIO) and Instituto de Astrofisica de Canarias (IAC) today signed a hosting agreement. While Mauna Kea in Hawaii continues to be the preferred choice for the location of the TMT, the hosting agreement defines how the alternative site will be available if Mauna Kea proves infeasible.

“This is an important step for TMT,” said TMT Executive Director Ed Stone. “We want to ensure we have by April 2018 a site suitable to start construction should Mauna Kea not be feasible. We now have a signed agreement and are moving ahead with the appropriate government approvals so that everything will be in place if needed.”

The bilateral hosting agreement governs the conditions for hosting TMT at Observatorio del Roque de los Muchachos (ORM) on La Palma, its future operation and eventual demolition, removal and restoration of the site. Among the terms of the 75-year agreement are the right to construct and operate, the use of the land, access to infrastructure and common services, and headquarters facilities in La Palma and Tenerife. In return, Spain will receive 10 percent of the observation time, once operational.

Already the site of diverse international observatories, ORM provides exceptional conditions for astronomical observations. It offers an excellent site for TMT’s core science goals.

“We are excited about the possibility of welcoming TMT to the Observatorio del Roque de los Muchachos on La Palma,” said IAC Director Rafael Rebolo. “The capacity for outstanding astronomical discoveries is beyond thrilling. This hosting agreement serves well TIO, Spain and the worldwide astronomy community.”

Added Caltech Professor and TIO board member Tom Soifer, “The true spirit of collaboration between TIO and Spain has been really uplifting. We thank the IAC and Spain for their tremendous support and for the warm welcome to ORM.”

About TMT:

The Thirty Meter Telescope (TMT) Project has been developed as collaboration among the California Institute of Technology (Caltech), the University of California (UC), the Association of Canadian Universities for Research in Astronomy (ACURA), and the national institutes of Japan, China, and India. The TMT International Observatory LLC (TIO), a non-profit organization, was established in May 2014 to carry out the construction and operation phases of the TMT Project. The Members of TIO are Caltech, UC, the National Institutes of Natural Sciences of Japan, the National Astronomical Observatories of the Chinese Academy of Sciences, the Department of Science and Technology of India, and the National Research Council (Canada); the Association of Universities for Research in Astronomy (AURA) is a TIO Associate. Major funding has been provided by the Gordon & Betty Moore Foundation.

For more information about the TMT project, visit tmt.org, www.facebook.com/TMTHawaii or follow @TMTHawaii.

About IAC:

The Instituto de Astrofísica de Canarias (IAC) is a public research organization funded by the Governments of Spain (Ministerio de Economía, Industria y Competitividad MINECO) and the Canary Islands with participation of the University of La Laguna and the Consejo Superior de Investigaciones Científicas. The IAC hosts two Observatories (Teide and Roque de los Muchachos) where research institutions from more than 20 countries operate optical, infrared and microwave telescopes including the Spanish 10.4 m Gran Telescopio Canarias.

For more information about the IAC, visit www.iac.es

1st Reflown SpaceX Falcon 9 Soars to Orbit with SES-10 Revolutionizing Rocketry Forever

2 Apr, 2017 by Ken Kremer

Commercial Space, Dragon, Earth, Falcon 9, International Space Station, Kennedy Space Center, Launches, NASA, Space Exploration, Space Exploration Technologies, SpaceX

KENNEDY SPACE CENTER, FL – SpaceX CEO Elon Musk's Billion dollar bet on rocket recycling paid off beautifully when the world's first ever reflown rocket booster – a SpaceX Falcon 9 – roared off NASA's historic pad 39A at the Kennedy Space Center and successfully delivered the next generation SES-10 TV satellite to orbit and simultaneously shot revolutionary shock waves reverberating forever across the rocket industry worldwide.

Space Station Drama After Vital Micrometeorite Shielding Floats Away

Article Updated: 2 Apr, 2017

by Matt Williams

This past week (on Thurs. March 30th), two crew members of Expedition 50 conducted an important spacewalk on the exterior of the International Space Station. During the seven hours in which they conducted this extravehicular activity (EVA), the astronauts reconnected cables and electrical connections on a new Pressurized Mating Adapter (PMA-3) and installed four new thermal protection shields on the Tranquility module.

These shields were required to cover the port that was left exposed when (earlier in the week) the PMA-3 was removed and installed robotically on the Harmony module. In the course of the EVA, the two astronauts – Commander Shane Kimbrough and Flight Engineer Peggy Whitson – were forced to perform an impromptu patch up job when one of the shield unexpectedly came loose.

While things flying off into space is not entirely unusual, on this occasion, there were concerns given the size and weight of the object. This shield measures about 1.5 meters by 0.6 meters (5 feet by 2 feet) and is 5 centimeters (2 inches) thick. It also weighs a little over 8 kg (18 lbs), which would make it a serious impact hazard given the relative velocity of orbital debris (28,000 km/h).

Spacewalk support personnel quickly at the Johnson Space Center, looking for a solution to the loss of thermal and micrometeoroid shield. Credit: NASA

After coming loose, the bundled-up shield quickly floated away and became visible in the distance as a white dot. In response, a team from the Mission Control Center at NASA's Johnson Space Center began monitoring the shield as it drifted. At the same time, they began working on a contingency plan to substitute the shielding, and advised the astronauts to finish covering the port with the PMA-3 cover Whitson removed earlier that day.

The plan worked, and the cover was successfully installed, providing thermal, micrometeoroid and orbital debris protection for the port. Kimbrough and Whitson finished their EVA at 2:33 pm EDT, having successfully installed the remaining shields on the berthing mechanism port. A few hours after it came loose, Mission Control also determined that the shield posed no risk to the ISS and will eventually burn up in Earth's atmosphere.

Before concluding their spacewalk, Kimbrough and Whitson also installed what has been nicknamed a "cummerbund" around the base of the PMA-3 adapter. This cloth shield – which also provides micrometeorite protection – is so-named because it fits around the adapter in a way that is similar to how a tuxedo's cummerbund fits around a person's waist.

Another highlight of this spacewalk was the fact that Peggy Whitson set two new records with this latest EVA. In addition to setting the record for the most spacewalks by a female astronaut (eight), she also set the record for most accumulated time spent spacewalking – just over 53 hours – by a female astronaut. The 57-year old astronaut now ranks fifth on the list of all-time spacewalking by any astronaut.

Astronaut Peggy Whitson signs her autograph near an Expedition 50 mission patch attached to the inside the International Space Station. Credit: NASA

On top of all that, Expedition 50 is Whitson's third mission to the ISS, and she has spent a total of 500 days in space – also a record for any female astronaut. She arrived aboard the ISS

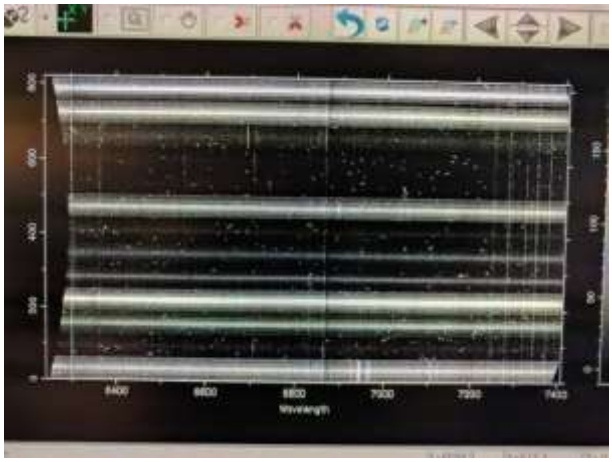
aboard the Soyuz MS-03 – along with ESA flight engineer Thomas Pesquet and Roscosmos flight engineer Oleg Novitskiy – and is scheduled to return to Earth in June (though she may remain there until September).

Four Planet 9 Candidates Located

Article Updated: 31 Mar , 2017

by Nancy Atkinson

A concentrated three-day search for a mysterious, unseen planet in the far reaches of our own solar system has yielded four possible candidates. The search for the so-called Planet 9 was part of a real-time search with a Zooniverse citizen science project, in coordination with the BBC's Stargazing Live broadcast from the Australian National University's Siding Spring Observatory.



A view of data from SAMI, a new multi-object integral field spectrograph at Siding Spring Observatory, which was used to look for the hypothetical Planet 9. Credit: Dilyar Barat via Twitter.

Researcher Brad Tucker from ANU, who led the effort, said about 60,000 people from around the world classified over four million objects during the three days, using data from the SkyMapper telescope at Siding Spring. He and his team said that even if none of the four candidates turn out to be the hypothetical Planet 9, the effort was scientifically valuable, helping to verify their search methods as exceptionally viable.

"We've detected minor planets Chiron and Comacina, which demonstrates the approach we're taking could find Planet 9 if it's there," Tucker said. "We've managed to rule out a planet about the size of Neptune being in about 90 per cent of the southern sky out to a depth of about 350 times the distance the Earth is from the Sun.

Researchers from Australian National University pose with BBC astronomers Chris Lintott, Brian Cox and Dara O'Brien. Credit: ANU.

Last year, Caltech astronomers Mike Brown and Konstantin Batygin found indirect evidence for the existence of a large planet when they found that the orbits of several different Kuiper Belt Objects were likely being influenced by a massive body, located out beyond the orbit of Pluto, about 200 times further than the distance from the Sun to the Earth. This planet would be Neptune-sized, roughly 10 times more massive than Earth. But the search is difficult because the object is likely 1000 times fainter than Pluto.

The search has been on, with many researchers working on both new observations and sifting through old data. This recent project used archival data from the Skymapper Telescope.

"With the help of tens of thousands of dedicated volunteers sifting through hundreds of thousands of images taken by SkyMapper," Tucker said, "we have achieved four years of scientific analysis in under three days. One of those volunteers, Toby Roberts, has made 12,000 classifications."

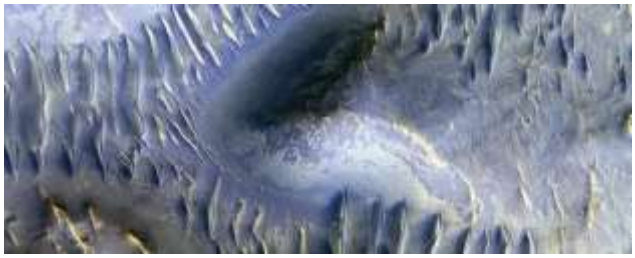
The Ever-Working Mars Orbiter Passes 50,000 Orbits

Published: 30 Mar , 2017

by Evan Gough

Most of us never do one thing 50,000 times in our life. So for NASA's Mars Reconnaissance Orbiter (MRO), completing 50,000 orbits around the red planet is a big deal. And, it only took 10 years to do so.

The MRO could be called one of NASA's flagship missions. It's presence in orbit around Mars has helped open up our understanding of that planet immensely. And it's done so while providing us a steady stream of eye candy.



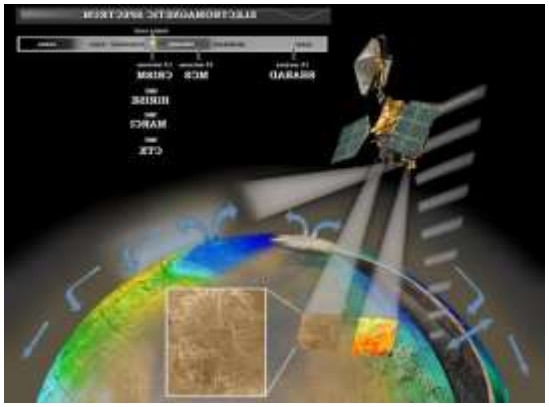
This recent image from MRO's HiRise camera shows dune structure inside an impact crater. Image: NASA/JPL/University of Arizona

MRO was launched in 2005 and reached Mars orbit in March, 2006. After 10 years at work, it has accomplished a lot. In a recent press release, NASA calls the MRO "the most data-productive spacecraft yet." Though most of us might know the orbiter because of it's camera, the High-Resolution Imaging Science Experiment (HiRise), the MRO actually has a handful of other instruments that help the orbiter achieve its objectives. In broad terms, those objectives are:

to study the history of water on Mars

to look at small scale features on the surface, and identify landing sites for future Mars missions

to act as a communications relay between Mars and Earth



MRO investigating Martian water cycle – This artist's concept represents the "Follow the Water" theme of NASA's Mars Reconnaissance Orbiter mission. The orbiter's science instruments monitor the present water cycle in the Mars atmosphere and the associated deposition and sublimation of water ice on the surface, while probing the subsurface to see how deep the water-ice reservoir extends. Image: By NASA/JPL/Corby Waste – http://photojournal.jpl.nasa.gov/catalog/PIA07241 (image link), Public Domain, https://commons.wikimedia.org/w/index.php?curid=374810 (Larger image here.

MRO's HiRise camera gets all the glory, but it's another onboard camera, the Context Camera (CTX), that is the real workhorse. The CTX is a much lower resolution than the HiRise, but its file sizes are much more manageable, an important consideration when every file has to travel from Mars to Earth—an average distance of about 225 million km.

CTX has captured 90,000 images so far in MRO's mission, and each one captures details smaller than a tennis court. In the course of the mission so far, CTX has images that cover 99.1% of the Martian surface. Over 60% of the planet has been covered twice.

"Reaching 99.1-percent coverage has been tricky because a number of factors, including weather conditions, coordination with other instruments, downlink limitations, and orbital constraints, tend to limit where we can image and when," said Context Camera Team Leader Michael Malin of Malin Space Science Systems, San Diego.

Malin said, "Single coverage provides a baseline we can use for comparison with future observations, as we look for changes. Re-imaging areas serves two functions: looking for changes and acquiring stereoscopic views from which we can make topographic maps."

Because the CTX captures image of the same surface areas twice, it documents changes on the surface. There have been over 200 instances of impact craters appearing in a second image of the same area. Scientists have used this to calculate the rate that meteorites impact Mars.

The instruments on board the MRO work as a team. The CTX can capture images of areas of interest, and the HiRise can be used for higher-resolution images of the same area. By locating fresh impact craters, then studying them more closely, the MRO has helped discover the presence of what looked like sub-surface ice on Mars. A third instrument, the Compact Reconnaissance Imaging Spectrometer for Mars (CRISM), confirmed the presence of ice.

Juno's Monday Jupiter Flyby Promises New Batch of Images & Science

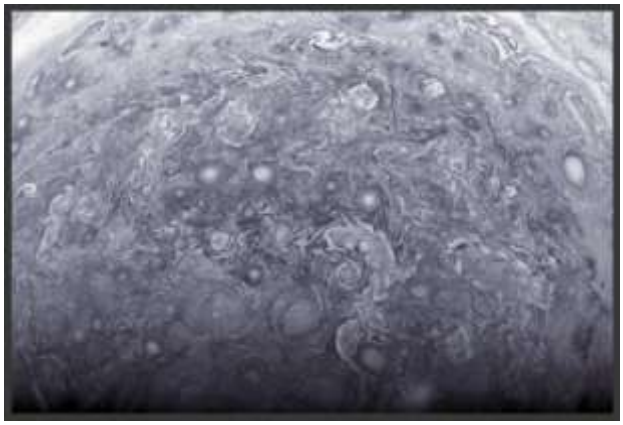
Published: 25 Mar , 2017

by Evan Gough

Juno is only part way through its mission to Jupiter, and already we've seen some absolutely breathtaking images of the gas giant. On Monday, the Juno spacecraft will flyby Jupiter again. This will be the craft's 5th flyby of the gas giant, and it'll provide us with our latest dose of Jupiter science and images. The first 4 flybys have already exceeded our expectations.

Juno will approach to within 4,400 km of Jupiter's cloud tops, and will travel at a speed of 207,600 km/h. During this time of closest approach, called a perijove, all of Juno's eight science instruments will be active, along with the JunoCam.

The JunoCam is not exactly part of the science payload. It was included in the missions to help engage the public with the mission, and it appears to be doing that job well. The Junocam's targets have been partly chosen by the public, and NASA has invited anyone who cares to to download and process raw Junocam images. You can see those results throughout this article.



This image of Jupiter's dancing cloud tops was captured during perijove 3. Image: NASA / JPL-Caltech / SwRI / MSSS / Kootenay Nature Photos © cc nc sa

This is Juno's 5th flyby, but only its 4th science pass. During Juno's first encounter with Jupiter, the science instruments weren't active. Even so, after only 3 science passes, we have learned some things about Jupiter.

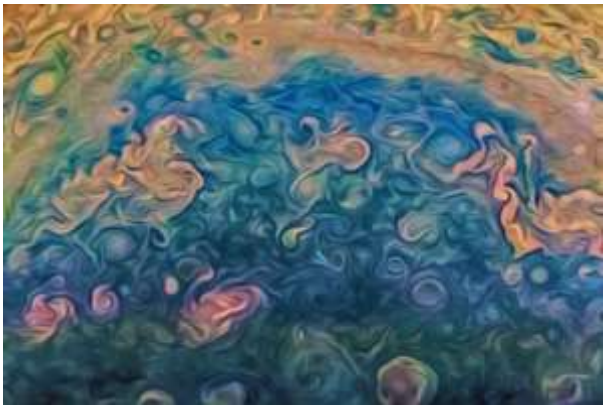
"We are excited to see what new discoveries Juno will reveal." – Scott Bolton, NASA's Principal Investigator for the Juno Mission

"This will be our fourth science pass — the fifth close flyby of Jupiter of the mission — and we are excited to see what new discoveries Juno will reveal," said Scott Bolton, principal investigator of Juno from the Southwest Research Institute in San Antonio. "Every time we get near Jupiter's cloud tops, we learn new insights that help us understand this amazing giant planet."

We've already learned that Jupiter's intense magnetic fields are much more complicated than we thought. We've learned that the belts and zones in Jupiter's atmosphere, which are responsible for the dazzling patterns on the cloud tops, extend much deeper into the atmosphere than we thought. And we've discovered that charged material expelled from Io's volcanoes helps cause Jupiter's auroras.

The South Pole of Jupiter, taken during perijove 3. Image: NASA / JPL-Caltech / SwRI / MSSS / Luca Fornaciari © cc nc sa

Juno has the unprecedented ability to get extremely close to Jupiter. This next flyby will bring it to within 4,400 km of the cloud tops. But to do so, Juno has to pay a price. Though the sensitive equipment on the spacecraft is protected inside a titanium vault, Jupiter's powerful radiation belts will still take a toll on the electronics. But that's the price Juno will pay to perform its mission.



Jupiter's dazzle as revealed by JunoCam and Shane Drever. Image: NASA / JPL-Caltech / SwRI / MSSS / Shane Drever © cc nc sa

Other missions, like Cassini, have been measured in years, while Juno's will be measured in orbits. And once it's completed its final orbit, it will be sent to its destruction in Jupiter's atmosphere.

But before that happens, there's a lot of science to be done, and a lot of stunning images to be captured.

Here's an interview with the man leading the Juno Mission: Understanding Juno's Orbit: An Interview with NASA's Scott Bolton.

Here is the page for the JunoCam: https://www.missionjuno.swri.edu/junocam

Stephen Hawking Is Going To The Edge Of Space

Article Updated: 21 Mar, 2017

by Evan Gough

The VMS Eve (Virgin Mother Ship) carrys VSS Unity (Virgin Spaceship) for its first flight ever over Mojave, CA on Thursday September 8, 2016. Image: Virgin Galactic

SpaceShipTwo, Suborbital, Virgin Galactic

Stephen Hawking has spent decades theorizing about the Universe. His thinking on black holes, quantum gravity, quantum mechanics, and a long list of other topics, has helped shape our understanding of the cosmos. Now it looks like the man who has spent most of his adult life bound to a wheelchair will travel to the edge of space.

In an interview with Good Morning Britain, Hawking said "Richard Branson has offered me a seat on Virgin Galactic, and I said yes immediately." Hawking added that his "three children have brought me great joy—and I can tell you what will make me happy, to travel in space."

Stephen Hawking is one of the premier physicists and theorists of our time. Here he is being presented by his daughter Lucy Hawking at the lecture he gave for NASA's 50th anniversary. Credit: NASA/Paul Alers

It's all thanks to Richard Branson and his VSS Unity spaceship, which is still under development by The Spaceship Company. The Unity is designed to launch not from a rocket pad, but from underneath a carrier aircraft. By eliminating enormously expensive rocket launches from the whole endeavour, Branson hopes to make space more accessible to more people.

Virgin Spaceship Unity (VSS Unity) glides for the first time after being released from Virgin Mothership Eve (VMS Eve) over the Mojave Desert on 3rd, December 2016. Image: Virgin Galactic

The Virgin Galactic spacecraft is carried to an altitude of about 50,000 feet, then released from its carrier aircraft. Its rocket fires for about 1 minute, which accelerates the craft to three-and-a-half times the speed of sound, then is shut off. Then, according to Virgin Galactic, passengers will experience a "dramatic transition to silence and to true weightlessness."

As the video shows, the spacecraft is still in glide testing phase, where it is carried to altitude, then released. There is no rocket burn, and the craft glides down and lands at its base.

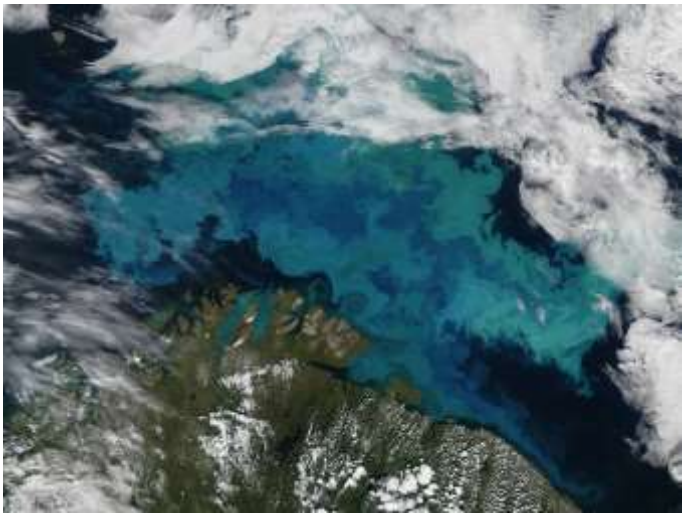
Comet 41P Tuttle Giacobini Kresak

First discovered by astronomer Horace Tuttle 1858, the comet was independently recovered by Michel Giacobini in 1907 and L'ubor Kresák in 1951 and its periodic nature was uncovered.

Note: We believe that the "May 3rd, 1858" date given for the discovery of this comet around ye ole Web is in fact, erroneous, as both Stellarium and Starry Night put the comet just a few degrees from the Sun on this date! Perhaps both programs are wrong looking that far back in time… but they're both *exactly* wrong. Perhaps a bit of astronomical detective work is in order? More to come!

NASA officials expect fewer Earth science missions in coming years

April 3, 2017 Stephen Clark



This plankton bloom in the Barents Sea is a colorful example of the microscopic ocean life that the PACE satellite is designed to observe globally. PACE is one of four Earth science missions identified for cancellation in the White House's budget blueprint. Credits: NASA's Earth Observatory

Expect fewer missions to study planet Earth in NASA's future, agency officials told an advisory group last week.

A blueprint of the Trump administration's proposed NASA budget would cancel four Earth science missions already in the agency's portfolio and slash research funding geared toward future projects. NASA officials said last week that the proposal, if enacted, will reduce the scope of the agency's Earth science program, but still continue development of many key missions.

"I'd say science funding was stable at the top line," said Robert Lightfoot, NASA's acting administrator. "Some missions in development will clearly not go forward in the Earth science arena."

The White House's budget document released March 16 was light on details, but the Trump administration proposed a $19.1 billion budget for NASA in fiscal year 2018, which begins Oct. 1. The agency's Earth science division would get $1.8 billion, roughly 6 percent less than enacted in fiscal year 2016.

"We continue to be committed to studying our home planet," Lightfoot said Thursday in an address to the NASA Advisory Council. "We'll reshape our focus based on the resources available to us, and the budget, while it's lower, is still in pretty good shape for us, for what we're going to do in Earth science."

Four Earth science missions are singled out for cancellation in the preliminary budget blueprint.

The Earth-observing component of the Deep Space Climate Observatory, a mission led by NOAA, is on the cutting block. The DSCOVR spacecraft, stationed at the L1 Lagrange point nearly a million miles from Earth, is primarily used by NOAA to produce space weather warnings, but it also hosts two Earth science instruments that fall under NASA management.

The budget overview released last month proposes the end of analysis and support work for the NASA-managed Earth science sensors on DSCOVR, which include a camera looking back at Earth providing multiple color images of the "blue marble" every day.

DSCOVR launched in February 2015 aboard a SpaceX Falcon 9 rocket.

The analysis work conducted by NASA on DSCOVR's Earth science instruments include "mission operations and algorithm monitoring, calibration and validation," said Michael Freilich, NASA's Earth science division director.

The other three Earth science missions that could be canceled include Orbiting Carbon Observatory-3, or OCO-3, an instrument built from spares developed for NASA's OCO-2 satellite. The OCO-3 instrument was planned to launch as soon as next year inside a commercial resupply ship for attachment to the International Space Station, where it was designed to monitor concentrations of greenhouse gases in Earth's atmosphere.

Another mission NASA recently approved to start development could also be ended.

A demonstration of sensor technology for the Climate Absolute Radiance and Refractivity Observatory, or CLARREO, was scheduled for launch to the space station in 2020. The CLARREO Pathfinder project, identified for cancellation in the White House budget overview, would have reduced technical risk for a future satellite mission in the 2020s aimed at detecting changing climate trends.

The fourth project that would fall victim to the Trump administration's proposed cuts is PACE, short for the Plankton, Aerosol, Cloud and ocean Ecosystem mission, set for launch around 2022. PACE is being developed as a standalone satellite to examine the interactions between Earth's atmosphere and oceans, with an emphasis on monitoring ocean color to study marine food webs, harmful algal blooms and other aquatic organisms.

NASA's planetary science division, which oversees the agency's robotic probes sent throughout the solar system, would fare better under President Trump's budget, which calls for $1.9 billion for interplanetary exploration next year. That is an increase of nearly 17 percent over the planetary science budget approved by Congress for fiscal year 2016.

NASA would see a 0.8 percent reduction in its overall budget from this year under the Trump proposal.

Thomas Zurbuchen, head of NASA's science mission directorate, said March 28 that the budget proposal would still offer a "sizable" level of funding in Earth science.

"What you see is the first step of the process that always happens," Zurbuchen told members of the National Academy of Science's Space Studies Board. "The first step of a process that, based on normal circumstances in the past, changes."

The White House budget office is expected to submit a more detailed line-by-line budget request to Congress in May. The "skinny" budget document released last month offers few details on Trump's vision for the federal budget, but it would cut most discretionary spending programs and seeks a $54 billion uptick in military spending.

"That will be what goes to Congress," Freilich said March 28. "That will represent the input to the congressional process to come up with an appropriations bill."

Lawmakers will write a budget for NASA later this year, or vote on a continuing resolution to keep the government's agencies operating with minor funding modifications.

"We have every expectation that the detailed FY18 budget

proposal that will be coming out in May puts flesh on the 'skinniness' of the blueprint," said Freilich, who added that NASA expects the detailed proposal to hold to the $1.8 billion top line number for the Earth science division included in last month's White House budget overview.

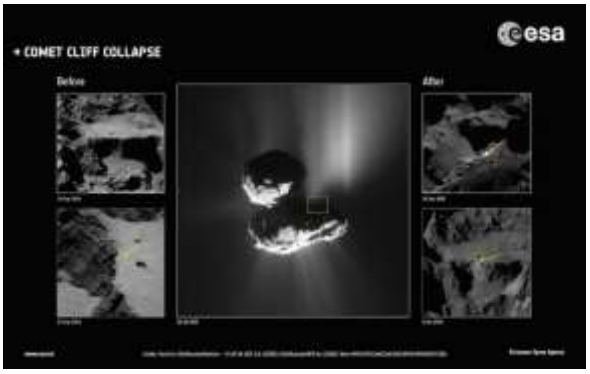
The budget blueprint did not mention any changes in funding for other major NASA Earth science missions, such as the ICE-Sat 2 satellite scheduled for launch in late 2018 to track changes in Earth's polar ice. The Earth science division's new "Earth Venture" initiative to select relatively low-cost research missions through competitions also remained untouched.

The Earth Venture program was pioneered by the development and launch of NASA's eight CYGNSS hurricane research satellites in December.

NASA officials offered no further information on additional Earth science cuts that could be proposed with the release of the final budget request in May, but Freilich did not rule out that more of his division's missions might be terminated by the time a final budget is approved by Congress and signed into law.

Rosetta's comet shows scars from swing through inner solar system

23 March 2017 Stephen Clark



This series of before-and-after views show the area of the Aswan cliff, which collapsed in July 2015 in conjunction with a strong outburst of gas and dust, seen by Rosetta in the long-range view at center. The same boulder is circled in all images to guide the eye when viewing the scene from different orientations. Credit: ESA/Rosetta/NavCam; ESA/Rosetta/MPS for OSIRIS Team MPS/UPD/LAM/IAA/SSO/INTA/UPM/DASP/IDA

Scientists examining imagery from Europe's Rosetta spacecraft have logged numerous changes to the face of comet 67P/Churyumov-Gerasimenko, from collapsing cliffs to a growing crack through the comet's neck that could foretell the eventual unraveling of the city-sized icy world.

The changes occurred as the comet traveled along the portion of its orbit closest to the sun, and comet 67P responded to the hotter conditions with dramatic outbursts of dust and ice, forcing the Rosetta spacecraft to move to a standoff position more than 100 miles away to keep out of the haze cloud.

Researchers said this week they have conclusively linked one of the outbursts to the collapse of a cliff on the comet, and scientists revealed other changes in the comet's appearance noticed after its passage near the sun in 2015.

The European Space Agency's Rosetta spacecraft arrived at the comet in August 2014, dropped a short-lived robot named Philae to its surface in November of that year, and spent more than two years observing the object's behavior, completing the first long-term close-up exploration of a comet in history.

Ground controllers intentionally crash-landed Rosetta on the comet in September 2016, ending the mission as the probe's power and fuel resources began to wane.

Scientists published two papers Tuesday in the journals Science and Nature Astronomy, describing the landscapes Rosetta saw before and after its perihelion, the point in its nearly six-and-a-half-year orbit nearest to the sun.

At perihelion in August 2015, comet 67P was about 115 million miles (186 million kilometres) from the sun, a point between the orbits of Earth and Mars.

Artist's concept of the Rosetta spacecraft during its descent to comet 67P/Churyumov-Gerasimenko. Credit: ESA/ATG medialab

The observations yielded new discoveries about how comets evolve, with powerful eruptions and outgassing that give them their fuzzy appearance through telescopes. Scientists believe comets contain primordial materials left over from the formation of the solar system, and they can glean important insights into the origins of the planets, and perhaps life itself, through studying the frozen mini-worlds.

Presenting their results at a press conference Tuesday at the Lunar and Planetary Science Conference near Houston, scientists showed images illustrating how the face of the comet changed during Rosetta's two-year exploration. They identified eroded cliff walls, a lengthening crack between the two lobes of the duck-shaped comet, a giant rolling boulder, transient pitted patterns, and recurring ripples in the comet's dune-like dusty veneer.

Before Rosetta, scientists only had comet imagery from high-speed flybys, and space missions had encountered just a single comet — Tempel 1 — more than once, revealing evidence of an eroding ridge on its surface.

"We had limited information on what other changes might happen on a comet — when do they actually start to kick in, and how long are these activities going on?" said Ramy El-Maarry, lead author of the paper published in Science and a member of the Rosetta science team at the University of Colorado, Boulder. "Also, (the) rate of change was something that we didn't have information about before Rosetta."

Maurizio Pajola, an astronomer at NASA's Ames Research Center, said his team was able to connect a powerful outburst seen by Rosetta's cameras on July 10, 2015, with the collapse of a cliff on the comet, the first time scientists have been able to make such a linkage.

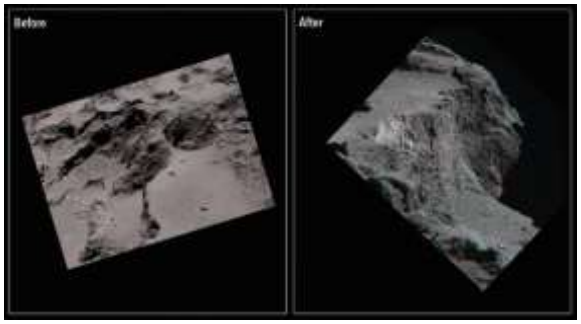
"Rosetta's images already suggested that cliff collapses are important in shaping cometary surfaces, but this particular event has provided the missing 'before–after' link between such a collapse, the debris seen at the foot of the cliff, and the associated dust plume, supporting a general mechanism where comet outbursts can indeed be generated by collapsing material," said Matt Taylor, ESA's Rosetta project scientist, in a statement.

"This is a really important point because we have different ideas on how outbursts can happen on the surface of a comet," Pajola said Tuesday at the science conference in Texas. "There are different reasons, but this is one of the possibilities, and we can really validate it."

Experts calculated that the outburst came from the comet's Seth region, home to a cliff first seen in September 2014, soon after Rosetta drew close to comet 67P. The scarp had a 230-foot-long (70-metre), 3-foot-wide (1-metre) fracture near its edge.

Pajola and his team compared two images of the cliff captured July 4 and July 15. The first showed the feature — named the Aswan cliff — intact with the previously-observed crack, but the cliff's shape and appearance had changed dramatically by the time Rosetta returned to take the second picture.

"We were like Sherlock Holmes," Pajola said of the detective work. "We were trying to go back in time and trying to see when this cliff was collapsing."



Anaglyph images of the Aswan cliff showing the overhang before (left) and after (right) it collapsed. The anaglyph images were prepared for evaluating the volume of overhang that detached in July 2015. Note the orientation between the two images is different. The images are best viewed using red–green/blue 3D glasses. ESA/Rosetta/MPS for OSIRIS Team MPS/UPD/LAM/IAA/SSO/INTA/UPM/DASP/IDA; M. Pajola

Once comet 67P's activity subsided as it headed toward the outer solar system again, Rosetta returned to the vicinity of the nucleus to record high-resolution snapshots of the surface, revealing the base of the ridge to be littered with boulders the size of cars that fell down the 440-foot (134-meter) face of the cliff.

Pajola said nearly 800,000 cubic feet (22,000 cubic metres) of rock, dust and ice fell away during the collapse, equivalent to roughly nine Olympic-sized swimming pools.

"The cliff collapse was not just a falling apart in two or three big pieces, but it was crumbling down, and while it was crumbling down, there was this outburst," Pajola said.

Scientists estimate about 1 percent of the collapsed material was lost to space, escaping the comet's tenuous gravity field and generating the bright cloud seen at the time by Rosetta.

According to Pajola, the cliff was in direct sunlight for only 90 minutes during each 12.4-hour day on the comet. But data from Rosetta indicated the surface temperature at the Aswan cliff rose from around minus 220 degrees Fahrenheit (minus 140 degrees Celsius) to 122 degrees Fahrenheit (50 degrees Celsius) in less than 20 minutes during each exposure to sunlight, a severe gradient not seen on other solar system bodies.

Scientists ruled out a sudden explosion triggered by solar heating because the collapse occurred when the Aswan cliff was in darkness. Instead, Pajola described how repeated thermal cycles could eat away at the ice buried inside the fracture at the top of the cliff.

"Thermal cracking can really propagate into the interior of the cliff," Pajola said. "You've got to consider that this area was already damaged. It was already fractured before the cliff collapse."

The ice inside the cliff acted like a glue holding the scarp together, and as heat reached inside the crack, the ice would have sublimated, or vaporized from a solid into a gas.

"All of a sudden, this glue is being lost," Pajola said. "Sublimation happens, then there is this erosion, and since we are talking about an overhanging cliff, this block just freely falls down, and while it's falling down, it's crumbling apart."

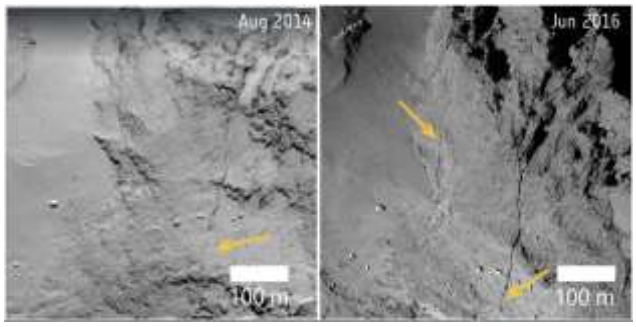
Scientists saw bright outcrops on the Aswan cliff after it caved in. Scientists interpret the markings, which were at least six times brighter than the rest of the comet, as water ice brought to the surface by the collapse.

The bright features dimmed in the months after the event as sunlight vaporized the water ice.

"We are seeing the fresh interior, and we are seeing that water ice is inside the comet," Pajola said.

The collapsed cliff was just one of many changes on the comet outlined by El-Maarry and his co-authors in Science.

A prominent 1,640-foot-long (500-metre) crack in the nucleus's neck grew by at least 100 feet (30 metre) during Rosetta's time at comet 67P, and a new nearly 500-foot-long (150-metre) fracture also appeared, El-Maarry said.



These images show the growth of a 1,600-foot (500-meter) crack in the comet's next over the course of Rosetta's mission, and the appearance of a new fracture nearby. Credit: ESA/Rosetta/MPS for OSIRIS Team MPS/UPD/LAM/IAA/SSO/INTA/UPM/DASP/IDA

Scientists attribute the large-scale fractures to the comet's faster spin rate from torque introduced by jets activated by the warmer conditions at perihelion.

"The comet actually speeds up due to this activity around perihelion, and when it speeds up, models have shown that you're going to introduce stresses into that body as it rotates, which tend to concentrate in the neck region," El-Maarry said. "So these stresses would lead to the development of new fractures, or the evolution of pre-existing ones."

By the end of the mission, the Rosetta team determined that comet 67P completed one rotation 21 minutes faster than it did when the spacecraft pulled alongside the comet in 2014.

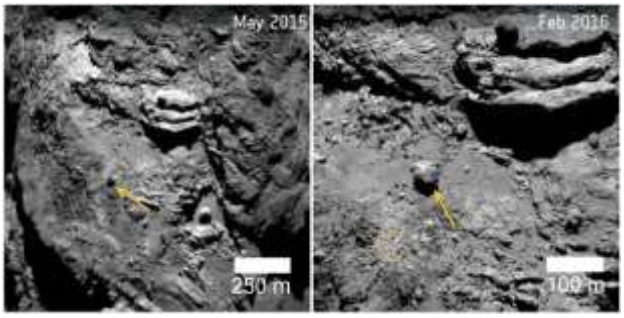
"The comet probably is eventually going to split up as it's going to speed up more and more," El-Maarry said. "We have evidence of that, but when is that exactly going to happen, we, of course, have no idea."

Scientists identified two boulders that moved during Rosetta's campaign at the comet. One of the objects, roughly the size of a truck, moved around 50 feet (15 metres) between March 2015 and June 2016.

A much larger boulder, around 100 feet (30 metres) in size with a mass of 282 million pounds (130 million kilogrammes), trekked a distance more than the length of a football field. Rosetta's science team believes the boulder was either lifted

by a forceful outburst, or surface material at the base of the object holding it in position eroded away, allowing it to roll downslope.

With the weak gravity at comet 67P, the force required to lift the boulder would be equivalent to the forced needed to hoist a 550-pound (250-kilogramme) object on Earth, according to El-Maarry.



These before-and-after images show the movement of a 100-foot (30-meter) boulder on comet 67P. Credit: ESA/Rosetta/MPS for OSIRIS Team MPS/UPD/LAM/IAA/SSO/INTA/UPM/DASP/IDA

Rosetta also saw up to 10 feet (3 metres) of dust and other surface material removed in the comet's Imhotep plains, excavating circular features and boulders that were only partially visible at the start of the mission's campaign at comet 67P.

El-Maarry said the comet lost, on average, about 3 feet (1 metre) of surface material globally, but the loss was uneven across the nucleus, with some regions seeing much more erosion than others.

Several scarps on the comet retreated by up to 150 feet (50 metres), moving at a rate of several feet per day at peak heating near perihelion.

"Scarp retreats were observed before on Comet Tempel 1, inferred by comparing images taken during flybys of the comet by NASA's Deep Impact in 2005, and Stardust-NExT in 2011," El-Maarry said. "What we were able to do with Rosetta was to monitor similar changes continuously, and at a higher resolution. Our observations additionally tell us that scarp retreat seems to be a common process on comets, specifically in smooth-looking deposits."

Rosetta observed transient changes, including the appearance of pitted patterns in 2015 that were erased by June 2016.

Recurrent ripples in the comet's Hapi region were spotted early in Rosetta's mission in late 2014, but the dune-like features disappeared by April 2015 to be replaced by a mysterious circular marking in mid-2015. By December 2015, the circular feature was gone, and the ripples were back.

"These pesky features just don't want to go away, and they seem to be intent in appearing on the comet in exactly the same location," El-Maarry said.

Scientists think the ripples are formed as sublimating gas coming from the comet's northern neck flows over the Hapi region.

"It will act a little bit like wind," El-Maarry said. "We think that the peculiar geometry of the comet, because it has this concave shape at the neck, is going to funnel this gas horizontally across the neck region, and that would be the reason why you're creating the ripples specifically at that particular location."

Most of the comet's changes are driven by sunlight and heating, El-Maarry said, but the icy object did not undergo a large-scale makeover.

"We didn't get fireworks, comet-splitting, things breaking up, and massive depressions being created," El-Maarry said. "So we didn't see major changes in the comet's landscape.

"We've seen cliff collapses, but nothing that has changed the landscape of the comet," he said. "That is telling us something. It means that we had much more activity earlier in the comet's lifetime."

Comet 67P was discovered in 1969 by Soviet astronomers Klim Churyumov and Svetlana Gerasimenko. An analysis of the comet's orbit showed that an encounter with Jupiter in 1959 put it on its current trajectory, which takes comet 67P more than twice as close to the sun than during the previous century, placing it in a much warmer environment conducive to an increase in outbursts and other activity.

El-Maarry said scientists have little information about the behaviour of the comet when it first entered the inner solar system. The "real fireworks" could have subsided over the last few decades as sunlight blew off more volatile constituents like carbon dioxide, he said.

Why Is Hydrogen the Most Common Element in the Universe?

By Laura Geggel, Live Science Staff Writer | April 3, 2017 08:27pm ET

A Hubble Space Telescope image of the distant universe.

Credit: NASA

Hydrogen is the most common element in the universe, but why is that?

To answer this question, "we need to go back to the Big Bang," said May Nyman, a professor of chemistry at Oregon State University.

The Big Bang created the elements on the periodic table, building blocks that help make up the universe. Each element has a unique number of subatomic particles: protons (positively charged), neutrons (neutral) and electrons (negatively charged). [What Are the Ingredients of Life?]

Hydrogen — with just one proton and one electron (it's the only element without a neutron) — is the simplest element in the universe, which explains why it's also the most abundant, Nyman said.

In stars, hydrogen atoms fuse to create helium — the second most common element in the universe, according to Encyclopedia.com. Helium has two protons, two neutrons and two electrons. Together, helium and hydrogen make up 99.9 percent of known matter in the universe, according to Encyclopedia.com.

Even so, there is still about 10 times more hydrogen than helium in the universe, Nyman said. Oxygen, the third most common element, is about 1,000 times less abundant than hydrogen, she added.

In general, the higher the atomic number, the less abundant is the element is, Nyman said.

Earth's composition, however, is different from that of the entire universe. For instance, oxygen is the most common element by weight in Earth's crust, followed by silicon, aluminum and iron, according to HyperPhysics, a site run by Georgia State University.

In the human body, the most common element by weight is oxygen, followed by carbon and hydrogen, according to HyperPhysics.

Hydrogen has a number of key roles in the human body. Hydrogen bonds help give DNA its signature twist, and it helps the stomach and other organs maintain the correct pH, or how acidic or basic it is, Nyman said.

"If your stomach gets too basic, hydrogen will be released to what it's bonded to," she said. "If it's too acidic, [hydrogen] will bond to something."

In addition, hydrogen allows ice to float on water (H20) because the hydrogen bonds push the frozen water molecules apart, making them less dense.

"Usually, substances are more dense when they're solid than when they're liquid," Nyman said. "Water is the only substance that is less dense than when it's [a] solid."

However, hydrogen can also be dangerous. Hydrogen gas reacting with oxygen led to the Hindenburg blimp catastrophe that killed 36 people in 1937, according to Airships.net. Moreover, hydrogen bombs can be incredibly destructive, although they have never been used as a weapon, "just demonstrated by the United States, USSR, Great Britain, France and China in the 1950s," Nyman said.

Hydrogen bombs, like atomic bombs, use a combination of nuclear fusion and fission reactions to cause destruction.

"[But] the big important difference between the atomic bombs that were dropped on Japan in the 1940s and the H -bomb is radioactive materials are not involved, so there are not the long-term problems of nuclear fallout and contamination, globally," Nyman said. "The danger is in the mechanical shock wave, not radioactivity."

Deepest X-ray Image Ever Made Contains Mysterious Explosion

Published: 31 Mar, 2017

by Matt Williams

For over sixty years, astronomers have been exploring the Universe for x-ray sources. Known to be associated with stars, clouds of super heated gas, interstellar mediums, and destructive events, the detection of cosmic x-rays is challenging work. In recent decades, astronomers have been benefited immensely from by the deployment of orbital telescopes like the Chandra X-ray Observatory.

Since it was launched on July 23rd, 1999, Chandra has been NASA's flagship mission for X-ray astronomy. And this past week (on Thurs. March 30th, 2017), the Observatory accomplished something very impressive. Using its suite of advanced instruments, the observatory captured a mysterious flash coming from deep space. Not only was this the deepest X-ray source ever observed, it also revealed what could be an entirely new phenomenon.

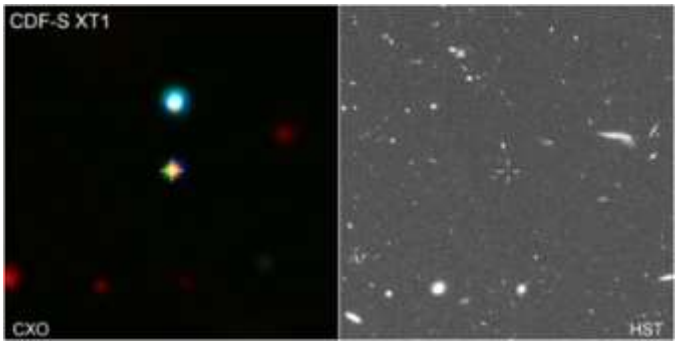
Located in the region of the sky known as the Chandra Deep Field-South (CDF-S), this X-ray emission source appeared to have come from a small galaxy located approximately 10.7 billion light-years from Earth. It also had some remarkable properties, producing more energy in the space of a few minutes that all the stars in the galaxy combined.

Originally detected in 2014 by a team of researchers from Penn State University and the Pontifical Catholic University of Chile in Santiago, Chile, this source was not even detected in the X-ray band at first. However, it quickly caught the team's attention as it erupted and became 1000 brighter in the space of a few hours. At this point, the researchers began gathering data using Chandra's Advanced CCD Imaging Spectronomer.

A day after the flare-up, the X-ray source had faded to the point that Chandra was no longer able to detect it. As Niel Brandt – the Verne M. Willaman Professor of Astronomy and Astrophysics at Penn State and part of the team that first observed it – described the discovery in a Penn State press release:

"This flaring source was a wonderful surprise bonus that we accidentally discovered in our efforts to explore the poorly understood realm of the ultra-faint X-ray universe. We definitely 'lucked out' with this find and now have an exciting new transient phenomenon to explore in future years."

Thousands of hours of legacy data from the Hubble and Spitzer Space Telescopes was then consulted in order to determine the location of the CDF-S X-ray source. And though scientists were able to determine that the image of the X-ray source placed it beyond any that had been observed before, they are not entirely clear as to what could have caused it.



X-ray (left) and optical (right) images of the space around the X-ray source, made with Chandra and the Hubble Space Telescope, respectively. Credit: NASA/CXC/F. Bauer et al.

On the one hand, it could be the result of some sort of destructive event, or something scientists have never before seen. The reason for this has to do with the fact that X-ray bursts also come with a gamma-ray burst (GRB), which appears to be missing here. Essentially, GRBs are jetted explosions that are triggered by the collapse of a massive star or by the merger of two neutron stars (or a neutron star with a black hole).

Because of this, three possible explanations have been suggested. In the first, the CDF-S X-ray source is indeed the result of a collapsing star or merger, but the resulting jets are not pointed towards Earth. In the second, the same scenario is responsible for the x-ray source, but the GRB lies beyond the small galaxy. The third possible explanation is that the event was caused by a medium-sized black hole shredding a white dwarf star.

Unfortunately, none of these explanations seem to fit the data. However, these research team also noted that these possibilities are not that well understood, since none have been witnessed in the Universe. As Franz Bauer – an astronomer from the Pontifical Catholic University of Chile – said: "Ever since discovering this source, we've been struggling to understand its origin. It's like we have a jigsaw puzzle but we don't have all of the pieces."

MEMBERS VIEWING LOGS and IMAGES

Viewing Log for 2nd of April

Finally able to get out for the first time in nearly a month, every time there was a clear night I was out doing my job of driving people around the south of England, normally from Heathrow Airport to Swindon or the local area?

Mark Radice of Salisbury Plain Observing Group (SPOG) was arranging a viewing session for Sunday night at Casterley Camp (south west of Upavon) and as I was free and the sky was clear I thought I would go along, even though it would be a 35 minute ride covering about 24 miles (one way)? This is about my limit of travel for a general viewing session as there are dark sights a lot closer to Swindon I could go to (Uffcott and Flaxlands to name a couple). I arrived about 20:25 and found Mark and Peter Triffitt (only other person to take Mark's call) already set up and waiting for the skies to go dark enough for viewing. I was using my usual Meade eight inch (203 mm) LX 90 GOTO telescope with a Pentax 14 mm eye piece (giving me a magnification of about 143) and had everything set up by 20:52.

I thought I would look at Mars before it got too close to the horizon; this planet has been hanging in the low western sky for months as it heads for solar conjunction later in the year. I could not make out any detail as the planet was only four arc seconds in diameter and a long way from us! By now Jupiter was slowly coming out of the murk of the eastern horizon so I had a look at the giant planet and could make out the usual two main weather belts plus another in the southern part of this planet. We would be waiting for a while before the shadow transit of the moon Europa so I thought I would do some pictures of the planets on view plus the Moon (which you could not miss as it was making shadows on the ground!), hopefully some of these will be in the magazine? By the time I had finished taking the pictures I thought about the planet Mercury (the one planet I have not seen many times from this country?). Too late was the answer from the hand controller, it had set about 30 minutes ago! Oh well I will have to try another time and hopefully before it goes into inferior conjunction (between Earth and the Sun) on the 20th of April.

Comet P41 (Tuttle-Giacobini-Kreasak) was travelling just above the handle of the Plough asterism and should be able to be seen with binoculars? Well I could not find it with binoculars or my telescope, Peter T could also not find it with his six inch refractor! It was up to Mark and his 14 inch scope to bag it! Looking thru Mark's scope the comet was not very bright at all; maybe the nearly half phase of the Moon was washing it out of the sky?

Now on to the main course for the evening and the shadow transit, it was now 22:26 and the shadow transit of Europa was due to start, so all telescopes where trained on to Jupiter. We could just make out the moon of Europa off the limb of Jupiter; it took nearly 10 minutes before the shadow became noticeable travelling across the surface. The Great Red Spot would not be viewable as it was on the far side and would not come around until after 02:00, well after my bedtime! So while the shadow travelled across I thought I would look at some other objects.

First stop was M 42, the great nebula in Orion this time not looking as good as it was now low in the western sky and the Moon was not too far away. Turning my scope the other direction I found M 82 in Ursa Major and this galaxy looked dimmer than usual? I put this down to the 40.2 % lit Moon washing deep sky objects out? I thought I would try some Caldwell (C) objects on my list, first object was C 45 a Spiral galaxy in Bootes followed by C 52 another Spiral in Virgo not sure if I could see either of these so I gave up with the list (did not tick them off of my viewed list just yet) until another night and the Moon is out of the way! Back to the transit and by now it was just over half way across the surface of Jupiter.

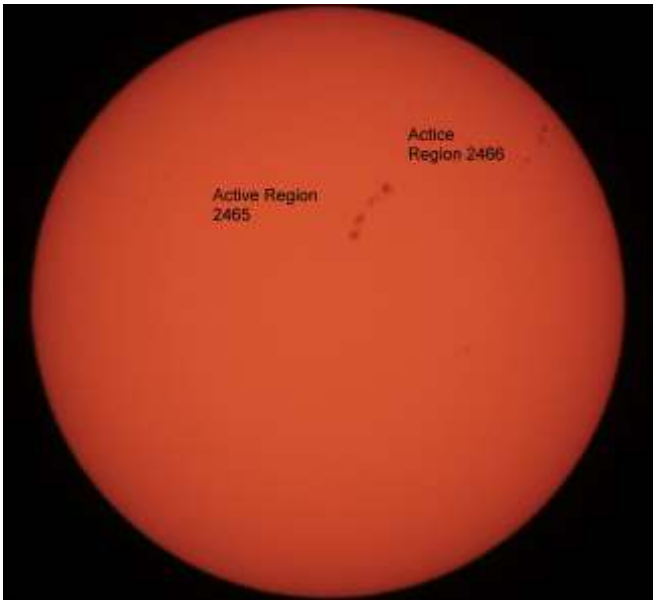
I was starting to get tired (started a driving job at 07:45 this morning) and I had a 35 minute trip back to Swindon so I packed up at 00:20 leaving the other two to carry on for a while longer? The weather for the evenings' session was brilliant, during the four hours I was there I only felt the wind on one occasion which did not last for more than two minutes (Casterley is on top of a hill and we have no protection from the elements at all, you can see the mask at Membury service station on the M 4 from here!) I also noticed there was hardly any dew on the car or equipment, the air must have been very dry at least the ground was dusty this time we were there, last time I came here I went thru a large puddle of water as the ground was on the wet side!

Clear skies.

Peter Chappell

Hi Andy,
Viewing log and pictures on the Moon and Sun from Sunday.
Moon (5.79 days old or 40.2 % lit) is a composite of nine pictures stitched together via Image Stitch Editor, pictures taken

with a Canon 60Da DSLR camera attached to a Meade LX90 telescope with a Televue 2.5 Barlow lens (giving f25) at 1/13th of a second at ISO 100.



Sun picture was taken with same camera attached to a 80 mm William's Optic refractor with solar filter attached to front end of telescope.

Peter Chappell

Log March 2017

64 variable star observations were loaded to the BAAVSS and AAVSO databases this month. Included in these are several observations of RR Tauri. This is an interesting star whose variability is unpredictable. Spectroscopy reveals a complex pattern of emission, absorption and polarisation as the visible maxima and minima occur. RR Tauri is believed to be a pre main sequence star of slightly larger mass than the sun and which may still be accreting material from a protoplanetary disc. Its not clear whether the variability arises because of obscuration of the star by orbiting material in the disc or because of an outbursts in the accretion disc close to the star.

Two other objects which have featured are the two Active Galactic Nuclei 3C 273 and Markarian 421. These objects are believed to be quasars with feeding supermassive black holes at their centres. As they feed they eject material along the magnetic poles at huge velocities and generate a beam of radiation. When the beams are directed towards the earth they are called Blazars and we are able to see them, even at very great distances. Markarian 421 is around 450,000 light years away but 3C 273 is 2.2billion light years away and is one of the brightest of these objects (it varies from approx Mag 12 to 13.6). Correlation of the 3C 273 radio source with a 13th mag star-like object in Virgo in the early 60's, allowed the huge redshift to be determined, making it probably the most distant known object at the time.

Evening of 2nd March

The lunar disc was about 40% illuminated resulting in Eudoxus and Aristoteles appearing right on the terminator. A little further away, Atlas and Hercules were still prominent as was Posidonius. Much further South, the crater chain, Theophilus, Cyrillus and Catharina were a little past their best but still spectacular. Particulary impressive were the Appenines which seemed to arc out beyond the terminator into the darkness as the mountains caught the first rays of the rising sun.

Tony Vale

Hi Andy,

Attached are Aurora images from Norway. Apologies if these are late for the April newsletter but I only got back yesterday.

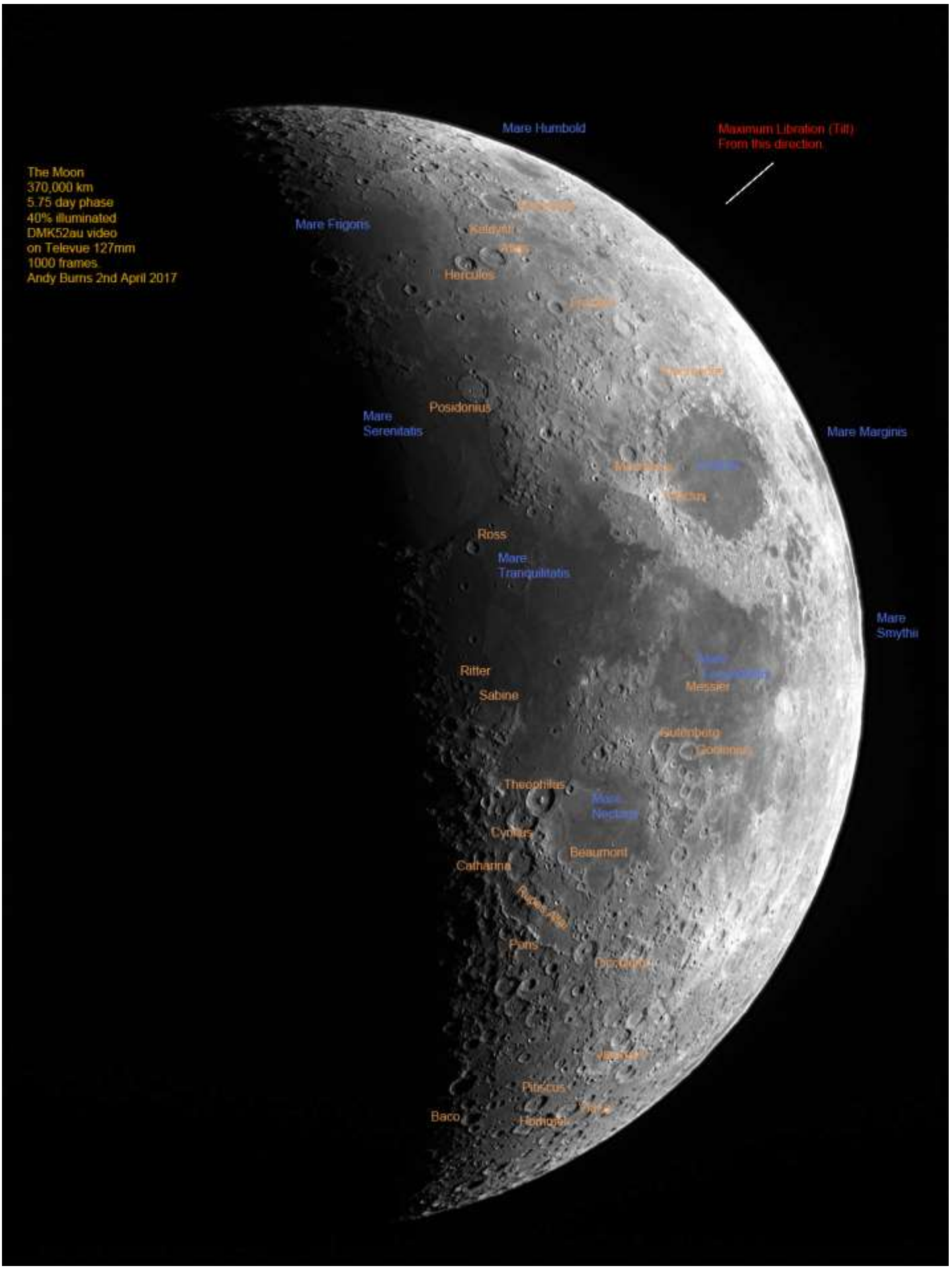
Unfortunately, the Aurora was even more elusive due to the weather. One of my Northern Lights excursion when in Tromso was cancelled due to bad weather.

Two of the attached images are at sea hence the blurred stars due to the rocking and rolling of the ship! The other image was at Alta but even there it was very cloudy.

All the images were taken with a Canon 1100D and a Tamron 10-24mm lens at 10mm (effective focal length 16mm), ISO 1600, F3.5, 10sec.

Regards,

John Dartnell


The Moon
370,000 km
5.75 day phase
40% illuminated
DMK52au video
on Televue 127mm
1000 frames
Andy Burns 2nd April 2017
Mare Humbold
Maximum Libration (Tilt)
From this direction
Mare Frigoris
Hercules
Posidonius
Mare
Serenitatis
Mare Marginis
Ross
Mare
Tranquilitatis
Mare
Smythii
Ritter
Sabine
Messier
Theophilus
Cyrillus
Beaumont
Catharina
Piccolomini
Vitruvius
Piteas
Baco

Here are pictures of the comet 41P Tuttle– Giacobini-Kresak near Thuban in Draco on 2nd April.

Plus Messier age challenge for my self, above the age next birthday and the one on the right is my age at present.

International Space Station from the 2nd April pass starting at 10pm, but it goes into the Earth's shadow almost directly over head. Note the trail starting in Taurus along side the Hyades, and the very bright Moon is on the left.

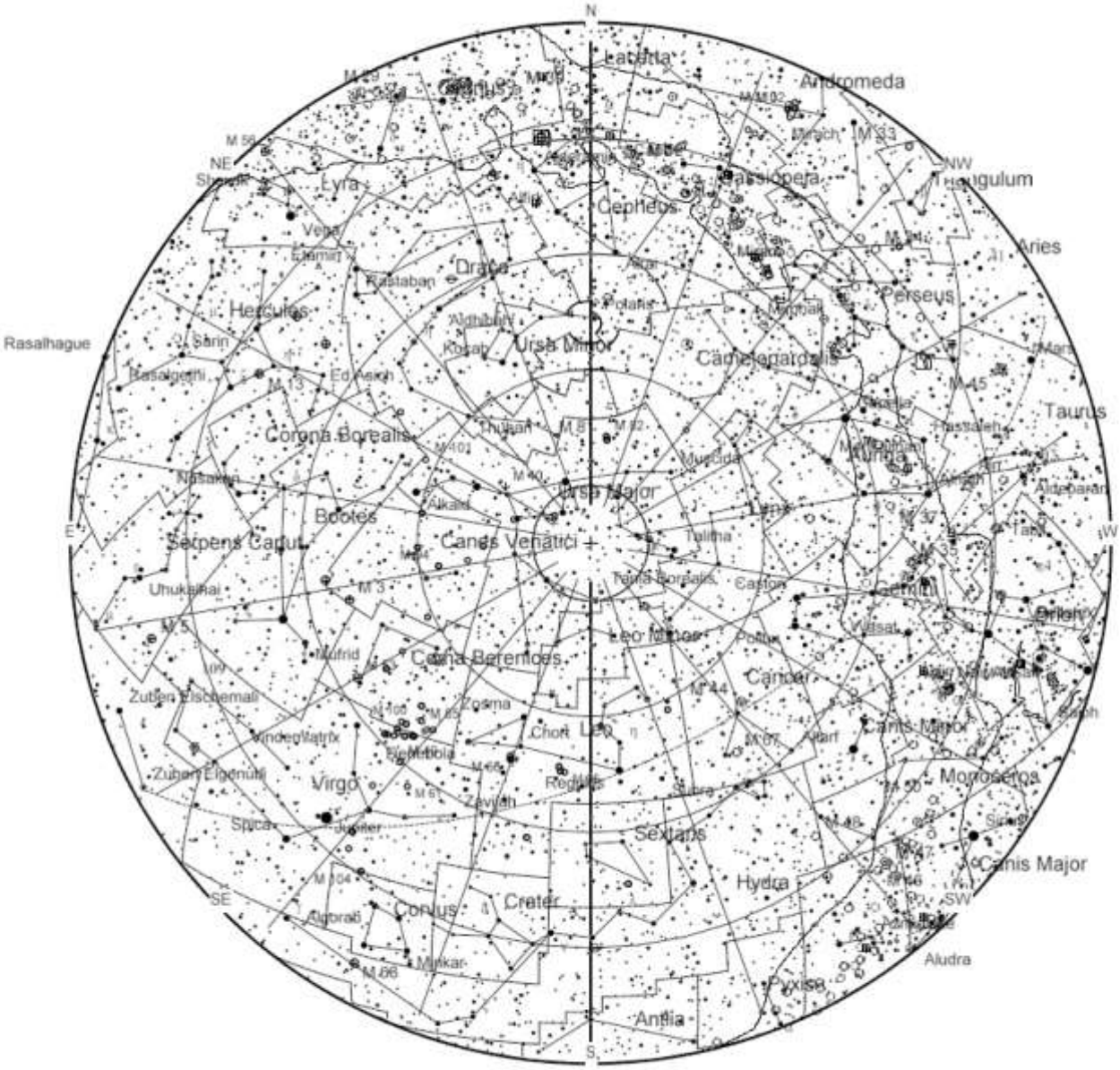
9 Exposures stacked using the free Startrails software.

The moonlight nicely reflecting off a neighbours garage.

12mm on 12-24mm lens, 8 second exposures using Nikon D7200.

Andy Burns

WHATS UP, April 2017



April 7 - **Jupiter at Opposition.** The giant planet will be at its closest approach to Earth and its face will be fully illuminated by the Sun. It will be brighter than any other time of the year and will be visible all night long. This is the best time to view and photograph Jupiter and its moons. A medium-sized telescope should be able to show you some of the details in Jupiter's cloud bands. A good pair of binoculars should allow you to see Jupiter's four largest moons, appearing as bright dots on either side of the planet.

April 11 - **Full Moon.** The Moon will be located on the opposite side of the Earth as the Sun and its face will be will be fully illuminated. This phase occurs at 06:08 UTC. This full moon was known by early Native American tribes as the Full Pink Moon because it marked the appearance of the moss pink, or wild ground phlox, which is one of the first spring flowers. This moon has also been known as the Sprouting Grass Moon, the Growing Moon, and the Egg Moon. Many coastal tribes called it the Full Fish Moon because this was the time that the shad swam upstream to spawn.

April 22, 23 - **Lyrids Meteor Shower.** The Lyrids is an average shower, usually producing about 20 meteors per hour at its peak. It is produced by dust particles left behind by comet C/1861 G1 Thatcher, which was discovered in 1861. The shower runs annually from April 16-25. It peaks this year on the night of the night of the 22nd and morning of the 23rd. These meteors can sometimes produce bright dust trails that last for several seconds. The crescent moon should not be too much of a problem this year. Skies should still be dark enough for a good show. Best viewing will be from a dark location after midnight. Meteors will radiate from the constellation Lyra, but can appear anywhere in the sky.

April 26 - **New Moon.** The Moon will located on the same side of the Earth as the Sun and will not be visible in the night sky. This phase occurs at 12:17 UTC. This is the best time of the month to observe faint objects such as galaxies and star clusters because there is no moonlight to interfere.

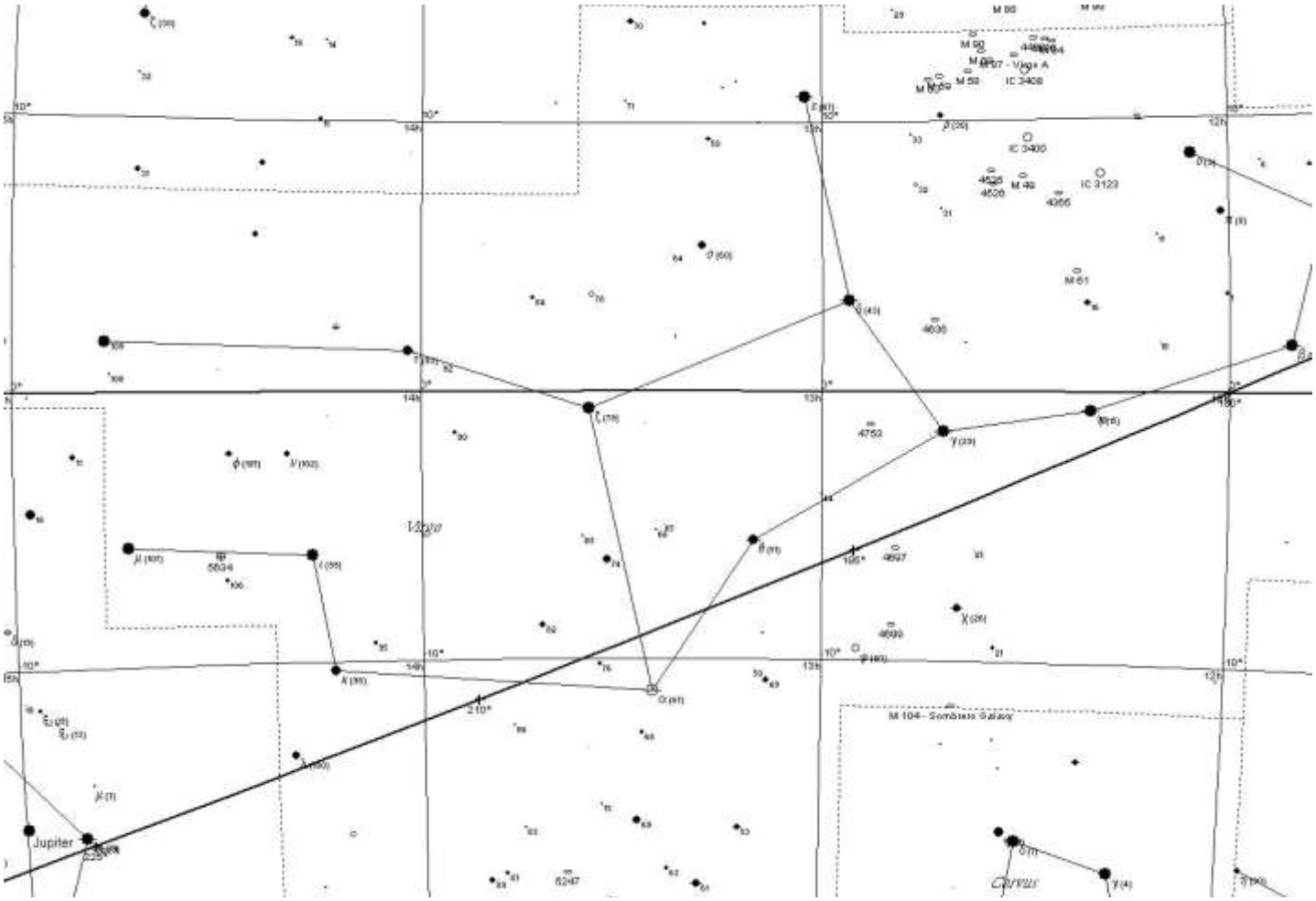
April 28th-=Moon occults Aldebaran at 7pm.

April 30th—Venus will be at its brightest as a morning object as it moves around from in front of the Sun.

Clear skies

Andy

CONSTELLATIONS OF THE MONTH: VIRGO



As one of the zodiacal signs, Virgo resides directly on the ecliptic plane and was one of the original 48 constellations charted by Ptolemy. It spans 1294 degrees and is the second largest constellation in the sky. Virgo also contains the point where the celestial equator crosses the ecliptic plane – the the autumn equinox. Between 9 and 15 stars make up its asterism and it contains 96 Bayer Flamsteed designated stars within its confines. Virgo is bordered by the constellations of Bootes, Coma Berenices, Leo, Crater, Corvus, Hydra, Libra and Serpens Caput. It is visible to all observers located at latitudes between +80° and ?80° and is best seen at culmination during the month of May.

There are two annual meteor showers associated with constellation Virgo. The Virginids peak on or about April 10th of each year and will appear to come from a point in the sky near Gamma. This is a relatively active and predictable meteor shower and you can expect to see about 10 meteors per hour on the average during a dark night from a dark location. The second is the Mu Virginids, which peak on or about April 25th. This is also a fairly reliable meteor shower and you can expect to see 7 to 10 meteors per hour on the average coming from an area near the Virgo/Leo border.

In mythology, Virgo is meant to represent the “Virgin”, but who exactly this woman is has never been established – only that she plays an important cultural role. Virgo is often portrayed carrying two sheaves of wheat, one of which is marked by the bright star Alpha – Spica – and it is the only astrological sign represented by a female. Perhaps she is Astraea, the virgin daughter of Zeus who was known as the goddess of justice. After all, Libra, the scales of justice is nearby!

Let’s begin our tour of Virgo with its brightest star – Alpha – the “a” symbol on our map. Alpha Viriginis is best known as Spica. Located 262 light-years away from Earth, 1.0 magnitude Spica glows with the combined light of four unresolved stars and has a visual luminosity 2100 times that of the Sun. As a rotating ellipsoidal variable, the four stars cause complex changes in luminosity by distorting the shape of the brightest components. The dominant star – Spica A – has a mass 11 times that of the Sun and fluctuates in physical size as it varies in brightness. The primary star is at maximum when smallest, giving it the highest photospheric surface temperature. Spica B has a mass of 7 suns. As a spectral type B, these two components produce more light in ultraviolet due to exceedingly high surface temperatures. Spica has two distant telescopic companions – magnitude 12 to the north-northeast, and magnitude 10.5 to the east-northeast.

Now head towards Beta – the “B”. Named Zavijava (sounds like something you’d get at Starbuck’s doesn’t it?) and located about 36 light years away from our solar system, this star holds a very special place in history because of its position in the sky. Since it is so near the ecliptic plane, it can frequently be occulted by the Moon, occasionally a planet, and even the Sun. In Zavijava’s case, it had the honor of being the star Einstein used during the solar eclipse of September 21, 1922 to determine the speed of light in space! What’s more, according to studies, Beta Virginis could host two or three Jupiter-sized planets – either brown dwarf stars in wide orbits or true planetary objects.

Ready for Gamma Virginis? That’s the “Y” symbol. Best known as Porrima, this binary star of nearly matched magnitudes was an easy object for amateur astronomers, but now the smaller apparent distance between the stars requires a larger telescope. Because of its relatively quick orbital period of 168.93 years, you’ll sometimes hear Porrima referred to as the “Shrinking Star”. At the time of this writing (early 2009), the pair is only separated by about .04″ and it will be another 11 years before they have moved apart enough again to be easily split with a small telescope!

Because there are massive amounts of deep sky objects in Virgo, annotating a map would be so cluttered it would be

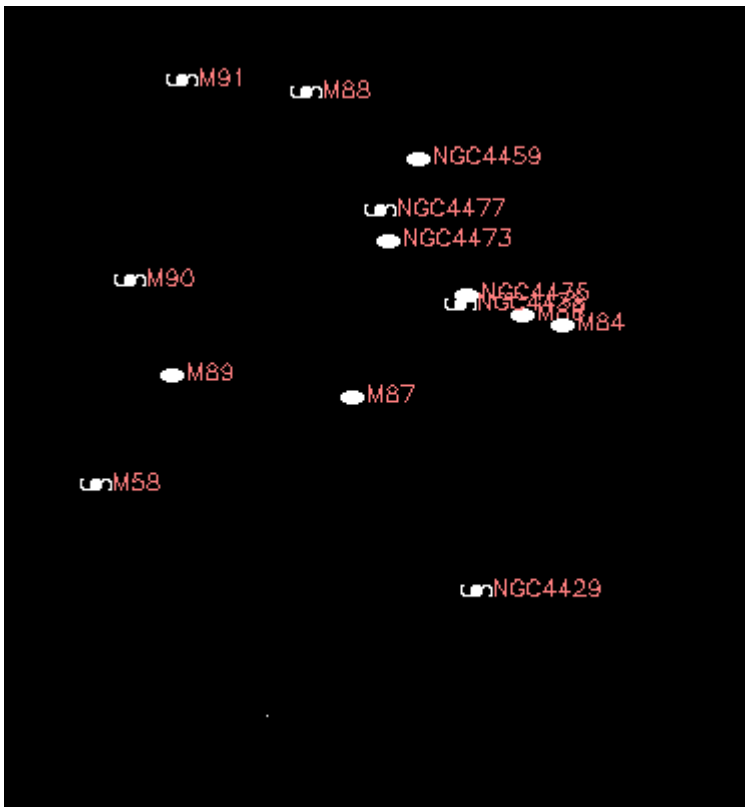
difficult to read. Let us begin first with the chart we have above which highlights the brighter objects in Virgo – ones easily seen with binoculars and small telescopes. Ready to dance?

Our first target will be Messier 104 (RA 12 : 40.0 Dec -11 : 37). Now, shake your fist at Spica… Because that's all it takes to find the awesome M104, eleven degrees due west. (If you still have trouble finding M104, don't worry. Try this trick! Look for the upper left hand star in the rectangle of Corvus – Delta. Between Spica and Delta is a diamond-shaped pattern of 5th magnitude stars. Aim your scope or binoculars just above the one furthest south.) Also known as the "Sombrero Galaxy" this gorgeous 8th magnitude spiral galaxy was discovered by Pierre Mechain in 1781, added by hand to Messier's catalog and observed independently by William Herschel as H I.43 – who was probably the first to note its dark inclusion. The Sombrero's rich central bulge is comprised of several hundred globular clusters and can be hinted at in just large binoculars and small telescopes. Large aperture telescopes will revel in this galaxy's "see through" qualities and bold, dark dustlane – making it a seasonal favorite!

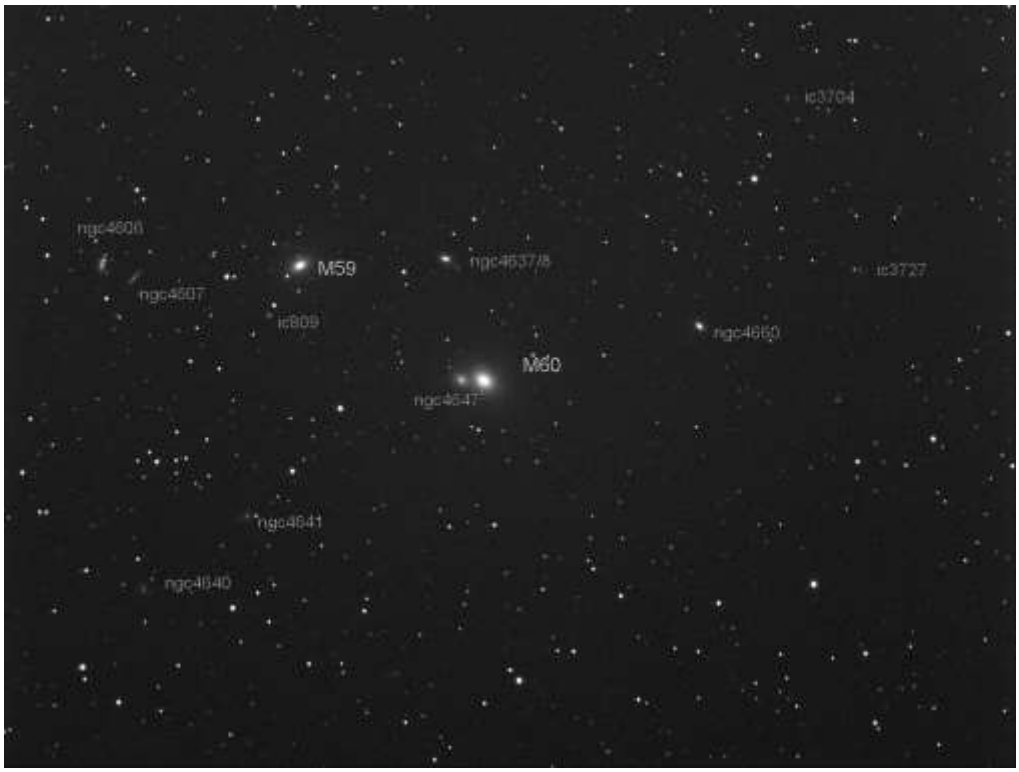
Now, let's take a look at one of the brightest members of the Virgo Cluster – Messier 49. Located about eight degrees northwest of Delta Virginis almost directly between a pair of 6th magnitude stars (RA 12 29 46 Dec +07 59 59), the giant elliptical galaxy M49 holds the distinction of being the first galaxy in the Virgo cluster to be discovered – and only the second beyond our local group. At magnitude 8.5, this type E4 galaxy will appear as an evenly illuminated egg shape in almost all scopes, and as a faint patch in binoculars. While a possible supernova event occurred in 1969, don't confuse the foreground star noted by Herschel with something new! Although most telescopes won't be able to pick this region apart, there are also many fainter companions near M49, including NGC 4470. But a sharp-eyed observer named Halton Arp noticed them and listed them as Peculiar Galaxy 134 – one with "fragments!"

Next up, Messier 87 (RA 12 : 30.8 Dec +12 : 24). It's a radio-source galaxy so bright it can be seen in binoculars – 8.6 magnitude M87, about two fingerwidths northwest of Rho Virginis. This giant elliptical galaxy was discovered by Charles Messier in 1781 and cataloged as M87. Spanning 120,000 light-years, it's an incredibly luminous galaxy containing far more mass and stars than the Milky Way Galaxy – gravitationally distorting its four dwarf satellites galaxies. M87 is known to contain in excess of several thousand globular clusters – up to 150,000 – and far more than our own 200.

In 1918, H. D. Curtis of Lick Observatory discovered something else – M87 has a jet of gaseous material extending from its core and pushing out several thousand light-years into space. This highly perturbed jet exhibits the same polarization as synchrotron radiation – a property of neutron stars. Containing a series of small knots and clouds as observed by Halton Arp at Palomar in 1977, he also discovered a second galaxy jet in 1966 erupting in the opposite direction. Thanks to these two properties, M87 made Arp's "Catalog of Peculiar Galaxies" as number 152. In 1954 Walter Baade and R. Minkowski identified M87 with radio source Virgo A, discovering a weaker galactic halo in 1956. Its position over an x-ray cloud extending through the Virgo cluster make M87 a source of an incredible amount of x-rays. Because of its many strange properties, M87 remains a target of scientific investigation. The Hubble Space Telescope has shown a violent nucleus surrounded by a fast rotating accretion disc, whose gaseous make-up may be part of a huge system of interstellar matter. As of today, only one supernova event has been recorded – yet M87 remains one of the most active and highly prized study galaxies of all. Capture it tonight!



Now we're heading for our more detailed map and the galaxy fields of Virgo about four fingerwidths east-southeast of Beta Leonis. As part of Markarian's Chain, this set of galaxies can all be fitted within the same field of view with a 32mm eyepiece



and a 12.5″ scope, but not everyone has the same equipment. Set your sights toward M84 and M86 and let's discover!

Good binoculars and small telescopes reveal this pair with ease as a matched set of elliptical galaxies. Mid-sized telescopes will note the western member of the pair – M84 – is seen as slightly brighter and visibly smaller. To the east and slightly north is larger M86 – whose nucleus is broader, and less intensely brilliant. In a larger scope, we see the galaxies literally "leap" out of the eyepiece at even the most modest magnifications. Strangely though, additional structure fails to be seen. As aperture increases, one of the most fascinating features of this area becomes apparent. While studying the bright galactic forms of M84/86 with direct vision, aversion begins to welcome many other mysterious strangers into view. Forming an easy triangle with the two Messiers and located about 20 arc-minutes south lies NGC 4388. At magnitude 11.0, this edge-on spiral galaxy has a dim star-like core to mid-sized scopes, but a classic edge-on structure in larger ones.

At magnitude 12, NGC 4387 is located in the center of a triangle formed by the two Messiers and NGC 4388. NGC 4387 is a dim galaxy – hinting at a stellar nucleus to smaller telescopes, while the larger ones will see a very small face-on spiral galaxy with a brighter nucleus. Just a breath north of M86 is an even dimmer patch of nebulosity – NGC 4402 – which needs higher magnifications to be detected in smaller scopes. Large apertures at high power reveal a noticeable dust lane. The central structure forms a curved "bar" of light. Luminosity appears evenly distributed end to end, while the dust lane cleanly separates the central bulge of the core. East of M86 are two brighter NGC galaxies – 4435 and 4438. Through average scopes, NGC 4435 is easily picked out at low power with a simple star-like core and wispy round body structure. NGC 4438 is dim, but even large apertures make elliptical galaxies a bit boring. The beauty of NGC 4435 and NGC 4438 is simply their proximity to each other. 4435 shows true elliptical structure, evenly illuminated, with a sense of fading toward the edges… But 4438 is quite a different story! This elliptical galaxy is much more elongated. A highly conspicuous wisp of galactic material can be seen stretching back toward the brighter, nearby galaxy pair M84/86.

Ready for bright galaxy Messier 58 (RA 12 : 37.7 Dec +11 : 49)? It's a spiral galaxy actually discovered by Messier in 1779! As one of the brightest galaxies in the Virgo cluster, M58 is one of only four that have barred structure. It was cataloged by Lord Rosse as a spiral in 1850. In binoculars, it will look much like our previously studied ellipticals, but a small telescope under good conditions will pick up the bright nucleus and a faint halo of spiral galaxy structure – while larger ones will see the central concentration of the bar across the core. Chalk up another Messier study for both binoculars and telescopes and let's get on to something really cool!

Around a half degree southwest are NGC 4567 and NGC 4569. L. S. Copeland dubbed them the "Siamese Twins," but this galaxy pair is also considered part of the Virgo cluster. While seen from our viewpoint as touching galaxies, no evidence exists of tidal filaments or distortions in structure, making them a line of sight phenomenon and not interacting members. While that might take little of the excitement away from the "Twins," a supernova event has been spotted in NGC 4569 as recently as 2004. While the duo is visible in smaller scopes as two, with soft twin nuclei, intermediate and large telescopes will see an almost V-shaped or heart-shaped pattern where the structures overlap. If you're doing double galaxy studies, this is a fine, bright one! If you see a faint galaxy in the field as well, be sure to add NGC 4564 to your notes. Moving about a degree north will call up face-on spiral galaxy M89, which will show a nice core region in most telescopes. One half degree northeast is where you will find the delightful 9.5 magnitude M90 – whose dark dust lanes will show to larger telescopes.

Virgo contains many, many more fine objects – so be sure to get a detailed star chart and spend some time with this great constellation!

Sources:
Wikipedia
SEDS
Chandra Observatory.

ISS PASSES For January to Mid Feb 2017 From Heavens Above website maintained by Chris Peat

Date	Brightness	Start	Highest point		End					
	(mag)	Time	Alt.	Az.	Time	Alt.	Az.	Time	Alt.	Az.
03 Apr	-3.9	21:07:40	10°	W	21:10:57	87°	N	21:12:53	23°	E
03 Apr	-1.6	22:44:11	10°	W	22:45:33	23°	W	22:45:33	23°	W
04 Apr	-4.0	21:52:03	10°	W	21:55:21	87°	S	21:55:31	79°	ESE
05 Apr	-3.8	20:59:55	10°	W	21:03:12	86°	N	21:05:26	19°	E
05 Apr	-1.9	22:36:26	10°	W	22:38:06	26°	W	22:38:06	26°	W
06 Apr	-3.8	21:44:16	10°	W	21:47:32	65°	SSW	21:48:00	55°	SSE
07 Apr	-3.9	20:52:07	10°	W	20:55:24	82°	S	20:57:53	16°	ESE
07 Apr	-1.9	22:28:45	10°	W	22:30:33	23°	WSW	22:30:33	23°	WSW
08 Apr	-3.1	21:36:28	10°	W	21:39:36	42°	SSW	21:40:26	34°	SSE
09 Apr	-3.5	20:44:15	10°	W	20:47:29	59°	SSW	20:50:20	13°	ESE
09 Apr	-1.5	22:21:19	10°	W	22:22:59	16°	SW	22:22:59	16°	SW
10 Apr	-2.2	21:28:46	10°	W	21:31:31	25°	SSW	21:32:54	19°	S
11 Apr	-2.7	20:36:25	10°	W	20:39:28	37°	SSW	20:42:30	10°	SE
12 Apr	-1.3	21:21:26	10°	WSW	21:23:16	14°	SW	21:25:07	10°	S
09 May	-1.6	04:13:33	10°	S	04:15:40	16°	SE	04:17:46	10°	E
10 May	-1.2	03:23:11	10°	SE	03:23:22	10°	SE	03:23:32	10°	SE
11 May	-2.5	04:04:34	15°	SSW	04:06:42	28°	SSE	04:09:33	10°	E
12 May	-2.0	03:13:49	18°	SSE	03:14:18	19°	SE	03:16:40	10°	E

Note the big blank between April 12 and May 9th, no sightings for this period in the evenings, nights or mornings.

END IMAGES, OBSERVING AND OUTREACH

A superb set of images of Venus setting while in extreme crescent phase.

Through an undriven 80mm skywatcher refractor.

Pete Glastonbury.

Right is an image of Venus from earlier in March 9th, using 5x powermate on 127mm Televue and DSLR camera through leaves.

Andy Burns

Date	Moon Phase	Observing Topic
2017		
Friday 28th April	Waxing crescent (sets 11pm)	Deep Sky & Lunar targets
Friday 26th May	Waxing crescent (sets around 10pm)	Deep Sky & Lunar targets

OUTREACH ACTIVITIES

Still awaiting clear Thursday to tie in with Chippenham Scouts.

Paragon School, Bath Changed to May daytime meeting

March 18th. Bath Does Science, Victoria Park. Do you want to set up solar viewing?